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Site Inspection Report
Lower Duwamish River (RK 2.5 to 11.5)
Seattle, Washington

Volume 1—Report and Appendices

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April 1999

WESTON.

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Seattle, Washington

Volume 1—Report and Appendices

SITE INSPECTION REPORT
LOWER DUWAMISH RIVER (RK 2.5 TO 11.5)
SEATTLE, WASHINGTON

VOLUME 1—REPORT AND APPENDICES

Prepared for
U.S. Environmental Protection Agency
Region 10
1200 Sixth Avenue
Seattle, Washington 98101

Contract No. 68-W9-0046
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April 1999

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ARCS QUALITY ASSURANCE CONCURRENCE

Site Inspection Report
Lower Duwamish River (RK 2.5 to 11.5)
Seattle, Washington

Project Name:	Site Inspections—Multiple Sites
Contract Number:	68-W9-0046
Work Assignment Number:	46-23-0JZZ
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SECTION 1

INTRODUCTION

Pursuant to United States Environmental Protection Agency (EPA) Contract No. 68-W9-0046, Multiple Site Inspections, and Work Plan Addenda (WESTON 1994a and 1998a) WESTON conducted a Site Inspection (SI) of sediments in the lower Duwamish River from river kilometer (RK) 2.5 to RK 11.5 (see Figure 1-1).

The EPA (SI) Site Investigation process evaluates actual or potential environmental hazards at a particular site relative to other sites across the nation for the purpose of identifying remedial action priorities. The SI, under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA), is intended to collect sufficient data to determine a site's potential for inclusion on the National Priorities List (NPL) and establish priorities for additional action, if warranted.

The data collection efforts in the lower Duwamish River were also designed to complement and support the other ongoing environmental and beneficial use projects being conducted by various agencies and interested parties to restore and enhance aquatic habitats within the Duwamish River corridor.

This document represents a summary of the objectives, sampling activities, and results of the Duwamish River SI. Included are site background information (Section 2), project description (Section 3), sampling and analysis results (Section 4), and references.

2. BACKGROUND

SECTION 2

BACKGROUND

2.1 SITE LOCATION AND DESCRIPTION

The Duwamish River originates at the confluence of the Green and Black rivers near Tukwila, WA, then flows northwest for approximately 21 kilometers (km), bifurcating at the southern end of Harbor Island to form the East and West waterways prior to discharging into Elliott Bay. The study area for this SI extends from the southern tip of Harbor Island (RK 2.5) to approximately 1.5 kilometers upchannel of the head of navigation (RK 11.5), also referred to as the upper turning basin or Turning Basin #3. The portion of the river that is maintained by the U.S. Army Corps of Engineers (Corps) as a federal navigation channel (i.e., the reach downchannel of Turning Basin #3) is typically referred to as the Duwamish Waterway. Navigation depths maintained by the Corps within the waterway generally range from –15 feet mean lower low water (MLLW) to -30 feet MLLW (WESTON 1994b).

The shorelines along the majority of the Duwamish Waterway have been developed for industrial and commercial operations, as the waterway serves as a major shipping route for containerized and bulk cargo. Common shoreline features within the study area include constructed bulkheads, with manmade structures such as piers, wharves and buildings extending over the water, and steeply sloped banks armored with riprap or other fill materials (e.g., concrete slabs and miscellaneous debris). Intertidal habitats are dispersed in relatively small patches (i.e., generally less than one acre in size), with the exception of Kellogg Island, which represents the largest contiguous area of intertidal habitat remaining in the Duwamish River (Tanner 1991).

The Duwamish River/Green River system drains an area of approximately 483 square miles, with peak runoff occurring during winter rains, and low flow throughout the late summer dry season (WESTON 1994b). Stream flow for most of the Duwamish River is regulated by the Howard-Hanson dam upstream of the junction of the Green and Black rivers. The Corps has limited peak discharges to 12,000 cubic feet per second (cfs) at Tukwila and minimum flows to as low as 200 cfs, with an average flow of 1,500 to 1,800 cfs.

Tidal effects have been observed throughout the entire reach of the Duwamish River, resulting in characteristic estuarine stratification of the river: surface water is generally fresh or brackish; bottom water is more saline. This bottom layer (referred to as a “salt wedge”) oscillates with the river based on river flow volume and tidal stage, but tends to be persistent under low flow conditions and high tidal magnitude, being detected as far as 16 km upstream (WESTON 1994b).

Bottom sediment composition is variable throughout the study area. Available historical surface sediment data suggest the presence of coarser sediments (e.g., medium and coarse sands) in nearshore areas adjacent to combined sewer overflow (CSO) and storm drain (SD) discharges and riprap or similarly constructed banks, as well as in subtidal (scour) areas in the vicinity of the bridges that cross the river (e.g., the First Avenue South and 16th Avenue South bridges). Finer-grained sediments (i.e., silts and clays) have generally been encountered in the remnant mudflats, along channel sideslopes, and within portions of the navigation channel.

2.2 INDUSTRIAL OPERATIONS AND PAST INVESTIGATIONS

Much of the upland areas adjacent to the project area are heavily industrialized, and marine traffic within the Duwamish Waterway is considered to be intensive. Historical or current commercial and industrial operations include cargo handling and storage; marine construction; boat manufacturing; maintenance and repair; marina operations; concrete and other stone material manufacturing and distribution; paper and metals fabrication; food processing; and airplane parts manufacturing. In addition, this reach of the river is the receiving body for discharges from numerous municipal SDs and CSOs, as well as multiple privately held outfalls and drains.

Numerous past investigations within the Duwamish Waterway have been conducted with varying scopes. Some of the historical studies focused on specific properties, while the remaining studies were riverwide and incorporated sediment sampling as only one component of the entire study. These past sediment studies have indicated that polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), metals (e.g., mercury), miscellaneous organic compounds (e.g., phthalate esters and chlorinated benzenes), pesticides, and organotins are present in the river sediments at concentrations that may cause deleterious effects to humans and aquatic organisms. PCBs and bis(2-ethylhexy)phthalate appear to be the most widespread contaminants of potential concern, followed by metals (primarily mercury and zinc) and PAHs. These contaminants may have entered the river via several transport pathways or mechanisms, including spillage during product shipping and handling, direct disposal or discharge, contaminated groundwater discharge, surface water runoff, stormwater discharge, or contaminated soil erosion.

2.3 REGIONAL GEOLOGY

The regional geology of the Seattle area is dominated by recent tectonics and Quaternary glaciations. Drift unconsolidated glacial materials and nonglacial deposits cover structurally deformed Tertiary bedrock comprising marine and estuarine sandstone, shale, and conglomerate, in addition to basalt, andesite, and volcaniclastic rocks. Drift units, separated by nonglacial sediments, from at least five major glaciations are recognized. The last glacier retreated from the Seattle area about 13,500 years before present. Each glaciation is characterized by a complex sequence of lacustrine (lake) deposits, advance outwash (river sediment), glaciomarine drift, till, and recessional outwash. The preservation of these deposits is patchy due to the erosion and deposition during the succeeding nonglacial and glacial intervals. The nonglacial intervals are represented typically by alluvial deposits (Galster and Laprade 1991).

The dominant post-glacial stratigraphy, which occupies relict subglacial meltwater channels scoured into advance outwash and older deposits during recession of the Puget lobe, consists of large, prograding river-mouth deltaic sequences that interfinger with marine embayment deposits. The Duwamish River valley is a relict trough and post-glacial ancient marine embayment, which has been filled with sediment in the past few thousand years by the prograding ancestral Duwamish river-mouth delta (Dragovich et al. 1994).

2.4 CHANNEL DYNAMICS

The original topography of the lower Duwamish River valley has been modified. Prior to development of the Duwamish River valley, the land surface consisted of low-lying floodplains and tidal flats. Prior to 1918, the Duwamish River was widely meandering. The natural slips cutting into the riverbank today are the only evidence of the river's original meandering course. During the period between 1910 and 1920, the lower portion of the river was channelized to create the Duwamish Waterway. The former river channel and surrounding floodplains were filled and graded to form the present-day topography.

2.5 AQUATIC RESOURCES AND CRITICAL HABITATS

The Duwamish River serves as a migratory route, nursery, and osmoregulatory transition zone for several species of Pacific salmon, including coho (*Oncorhynchus kistuch*), chinook (*O. tshawytscha*), chum (*O. keta*), pink (*O. gorbuscha*), as well as steelhead (*O. mykiss*) and cutthroat trout (*O. clarki*) (WESTON 1998b). Chinook and coho utilize Elliot Bay and the Duwamish estuary more extensively than any of the other species (WESTON 1998b). The runs are composed of native and hatchery-reared salmon as a result of the state hatchery program located on the Green River. As part of a continuing effort to protect dwindling Pacific salmon stocks, the Puget Sound chinook salmon has recently been listed as a threatened species under the Endangered Species Act.

The Duwamish River is part of the traditional fishing grounds for the Muckleshoot and Suquamish tribes. During seasonal migration runs, tribal members engage in a gillnet fishery for various commercially important salmonid species (e.g., chinook and coho salmon). The stocks also receive pressure from recreational fishing, which is popular at various public access locations along the lower reaches of the river.

There is a diverse assemblage of avian species present within the lower Duwamish River estuary. Both migratory and resident species of shorebirds, waterfowl, seabirds, songbirds, and raptors can be observed throughout much of the year. Piscivorous species recorded in the lower estuary include kingfisher and great blue heron. Raptors, such as hawks, bald eagles, and ospreys also reside and/or frequent the Duwamish corridor (WESTON 1994b). An active osprey nest located on the Birmingham Steel property was observed during the SI site reconnaissance, as well as during the field sampling program. It is also not uncommon to find bald eagles nesting in the underdeveloped open spaces or parks in West Seattle. The type of habitat use is not well documented for any of these species, but at a minimum, the lower Duwamish estuary serves as an adult and juvenile forage area.

Mammals such as otters and muskrats have been observed along the Duwamish River corridor. Marine mammals, including harbor seals (*Phoca vitulina*), and California sea lions (*Zalophus californianus*) are known to frequently forage in Elliott Bay and have been sighted in the Duwamish Waterway (WESTON 1994b). Both harbor seals and California sea lions are classified by the Washington Department of Fish and Wildlife as state monitor species (WESTON 1998b).

2.6 POTENTIAL CONTAMINANT TRANSPORT PATHWAYS AND RECEPTORS

2.6.1 Sediment

Sediments located in areas of direct deposition of waste materials or receiving contaminated surface water or groundwater drainage may act as a receptor, and, in turn, also act as a source, because the sediments can retain contaminants. In addition, sediments can act as a source of contaminants to locations distal from the original source materials because they can be transported by tides, currents, and wave action. Aquatic organisms represent additional receptors that may be impacted by sediment-bound contaminants due to exposure via dermal contact, respiration, or direct ingestion. Exposed lower trophic-order organisms also provide a pathway for exposure of higher trophic-order organisms via ingestion of contaminated prey. The potential for sediments to act as a receptor and a source was evaluated through the collection and chemical analysis of surface and subsurface sediments and sediment porewater from locations throughout the 9-kilometer study area.

2.6.2 Surface Water

The surface waters of the Duwamish River represent the principal surface water receptor. The primary and secondary ecological receptors associated with this aquatic habitat include anadromous and resident populations of fish, and numerous piscivorous birds, migratory waterfowl, raptors, and mammals. As described above, in addition to direct deposition, transport of contaminants to the surface waters of the Duwamish River may have occurred via stormwater runoff, direct discharge (i.e., storm drains and CSO discharges), tidal flushing, or groundwater transport. However, water quality was not directly evaluated as a part of this project.

2.6.3 Soil

Although this medium may represent a source of contamination or an exposure mechanism to terrestrial receptors, soil conditions associated with adjacent upland areas were not evaluated as part of this investigation. However, soil that may have been eroded and transported to nearshore sediment by stormwater flow was evaluated as part of the sediment pathway through collection of nearshore surface and subsurface sediment samples.

2.6.4 Groundwater

The groundwater pathway was not directly evaluated for this site, but the investigation of the sediment pathway would likely have captured areas of significant groundwater contamination that impacted sediment quality.

2.6.5 Air

The air pathway was not directly evaluated for this site, but the investigation of the sediment pathway would likely have captured potential impacts to riverine areas receiving significant particulate matter from the upland properties adjacent to the Duwamish River.

3. PROJECT DESCRIPTION

SECTION 3

PROJECT DESCRIPTION

3.1 SAMPLING OBJECTIVES

The EPA SI process is used to determine actual or potential environmental hazards at a particular site relative to other sites across the nation for the purposes of identifying remedial action priorities. This project was designed to collect sufficient data to support an SI evaluation for a 9-kilometer section of the Duwamish River, as well as other ongoing environmental efforts being conducted by various agencies and interested parties.

The purpose of this investigation was to provide a screening level evaluation of sediment quality in the Duwamish River. Accordingly, the following sampling objectives were identified for this investigation:

- Characterize the nature and areal extent of contaminant distribution in surface (0-10 cm) sediments.
- Preliminarily characterize the nature and vertical extent of sediment contaminant distribution in shallow (up to 1.21 m below mudline) subsurface sediments in localized areas.
- Obtain sediment porewater samples to evaluate the potential bioavailability of organotins and metals to aquatic receptors.

3.2 SAMPLE TYPES, NUMBERS LOCATIONS AND RATIONALE

In total, 300 stations were sampled and analyzed for various contaminants as part of this SI effort. The following is a breakdown of the number of stations and samples collected for each media. A graphical representation of station location and identification is depicted in Maps 3-1 through 3-3.

3.2.1 Surface (300 stations)

- 312 surface sediment samples
- 300 primary surface (0 to 10 cm) sediment samples
- 12 duplicate surface (0 to 10 cm) sediment samples

3.2.2 Subsurface (17 stations co-located with selected surface sediment sample station)

- 35 subsurface sediment samples
- 17 primary subsurface (0 to 0.6 m) sediment samples
- 1 duplicate subsurface (0 to 0.6 m) sediment samples

- 16 primary subsurface (0.6 to 1.2 m) sediment samples
- 1 duplicate subsurface (0.6 to 1.2 m) sediment sample

3.2.3 Porewater (15 stations co-located with selected surface sediment sample station)

- 16 surface sediment porewater samples
- 15 primary surface (0 to 10 cm) sediment porewater
- 1 duplicate surface (0 to 10 cm) sediment porewater

Surface, subsurface, and sediment porewater analyses performed at each station are depicted in Maps 3-4 through 3-6.

Split samples were provided to two interested parties owning properties adjacent to the study area. Information detailing interested parties and split sampling locations is provided in Table 3-1.

3.3 SAMPLING METHODS, ANALYTICAL REQUIREMENTS, AND STATION LOCATIONS

3.3.1 Sampling Methods

3.3.1.1 Surface Sediment Sampling

Subtidal surface sediments were collected using a stainless-steel modified 0.1 m^2 van Veen grab sampler in accordance with the procedures outlined in the sampling and analysis plan (SAP; WESTON 1998a). Up to eleven grabs were required at each station to achieve sufficient sediment volumes for bulk chemical and porewater analyses. Penetration depths for acceptable grabs ranged from 5 to 17 cm, depending on sediment type.

Observations of sediment composition were made for each sample and recorded on the appropriate field sample record forms (see Appendix A). Samples were placed in a stainless-steel container for homogenization; homogenized samples were placed in labeled precleaned sample jars or decontaminated high-density polyethylene (HDPE) buckets in the case of porewater samples. All sample containers were subsequently packed in coolers with ice for shipment.

3.3.1.2 Subsurface Sediment Sampling

Subsurface sediment samples were generally collected in accordance with the SAP (WESTON 1998a), with the exception of the size of the gravity corer selected for use. Based on past experience with coring in the Duwamish River, it was recommended that a 10.2 cm corer configured with a 1.52 m stainless-steel core barrel and a 317 kg weight stand be used, (Eaton 1998). Core recovery lengths varied throughout the study area depending on sediment type, and ranged from 0.7 to 1.4 (m), with an average recovery of 1.3 (m). A summary of the actual recovery lengths is provided in Table 3-2.

Core processing was conducted aboard the sampling vessel. Sediment from each core was extruded onto a decontaminated 1.5 (m) stainless-steel tray by elevating the tube at an angle. When necessary, the core was tapped with a rubber mallet to loosen the sediment from the core barrel. Care was taken to ensure that samples were extruded slowly to maintain the integrity of the core. Once the core was extruded onto the tray, observations of sediment composition were made and recorded on the appropriate field sample record forms (see Appendix B). Samples were then placed in stainless-steel bowls for homogenization; homogenized samples were subsequently placed in labeled precleaned sample jars. All sample containers were packed in coolers with ice for shipment.

3.3.2 Analytical Requirements

In general, all samples were analyzed in accordance with the methods and procedures specified in the SAP (WESTON 1998a). A few minor deviations from the proposed sample analytical requirements occurred, as follows:

- Surface sediment organotin analyses were inadvertently omitted during the field sample collection effort at stations DR013, DR109, DR139, DR190, and DR228.
- Physical conditions encountered in the field, including the presence of obstructions (e.g., overhead lines, moorage lines, moored vessels, shallow water, and impenetrable substrates composed of gravel, large rocks, and wood debris prohibited the collection of surface and subsurface sediment samples at several originally proposed sampling locations. As a result, some stations were deleted from the sampling effort, and alternate locations were evaluated as substitutes and sampled when appropriate conditions permitted. Where necessary, subsurface sediment analyses were also modified to coincide with that of the co-located surface sediments. A list of the samples affected, analytical changes, and justification for deviation is provided in Table 3-3.

Chemical analyses conducted at each surface sediment sampling location (including porewater stations) are presented in Tables 3-4 through 3-7. Chemical analyses conducted at each subsurface sediment sampling location are presented in Table 3-8.

3.3.3 Station Locations

3.3.3.1 Surface Sediment Stations

Considerable effort was made to collect surface sediment at or within close proximity of the sampling locations identified in the SAP. However, as described in Section 3.3.2, sampling locations had to be relocated due to physical obstructions or poor substrate conditions in several instances. Under the latter condition, multiple attempts were made before the given station was abandoned. In some cases, an appropriate alternate site was established and sampled accordingly. A description of the sites affected and the corrective action taken is provided in Table 3-3. Complete station coordinates are provided in Appendix C.

3.3.3.2 Subsurface Sediment Stations

Considerable effort was made to co-locate subsurface sediment sampling locations within 3 meters of the previously occupied surface sediment sampling locations. However, in several instances, subsurface sediment conditions prohibited adequate recovery of subsurface sediment. If an adequate sample could not be obtained after numerous attempts, then the station was abandoned or moved to an area of more favorable sampling conditions that had previously been sampled for surface (0 to 10 cm) sediment. Station-positioning modifications are detailed in Table 3-3. Complete station coordinates are provided in Appendix C.

3.4 SAMPLE HANDLING, PACKAGING, AND SHIPPING

Samples were handled, packaged, and shipped in accordance with the procedures specified in the SAP (WESTON 1998a).

3.5 DOCUMENTATION

All field documentation, sample designation and labeling, and chain of custody procedures were followed in accordance with the procedures specified in the SAP (WESTON 1998a).

3.6 EQUIPMENT DECONTAMINATION AND INVESTIGATION-DERIVED WASTE

Procedures specified in the SAP (WESTON, 1998a) for decontaminating equipment and disposing of investigation-derived wastes (IDW) were followed during field activities.

4. SAMPLING RESULTS

SECTION 4

SAMPLING RESULTS

The following sections present analytical data generated during this SI. A log summarizing individuals and affiliated agencies contacted during the course of this SI is provided in Appendix D. Chain-of-custody forms and data validation reports can be provided by EPA Region 10 upon request.

4.1 DATA PRESENTATION

Analytical data tables for surface, subsurface, and surface sediment porewater are presented in Appendix E, along with a list of data qualifiers. Analytical data are reported as follows:

- Sediment inorganic concentrations are expressed in units of milligram per kilogram (mg/kg) dry-weight
- Sediment organic concentrations are expressed in units of microgram per kilogram (µg/kg) dry-weight; sediment nonionic/nonpolar organics are also expressed in units of µg/kg-organic carbon (i.e., the dry-weight concentration was normalized to the organic carbon content of the sample by dividing the chemical concentration by the sample-specific decimal fraction of organic carbon).
- Sediment porewater inorganic concentration and organotin compound concentration are expressed in units of microgram per liter (µg/L).
- Sediment organotin concentrations are expressed in units of µg-ion/kg-dry weight and µg-ion/kg-organic carbon
- Sediment total organic carbon (TOC) content and grain size fractions are expressed as percentages.

4.2 DATA EVALUATION METHODS

4.2.1 Comparisons with Effects-Based Screening Values

Average and range of concentrations have been provided in the analytical results section of this report for selected analytes found to be at elevated concentrations and/or possess a wide distribution throughout the study area. Because information collected as part of this investigation may be used by various regulatory agencies, including the National Oceanic and Atmospheric Administration (NOAA), Washington State Department of Ecology (Ecology), and the EPA, the sediment and porewater data were also compared to several effects-based screening guidelines to assist in the interpretation of potential risks associated with exposures to these media at the site. The screening guidelines used for such comparisons include:

4.2.1.1 Sediment Screening Guidelines

- Washington State Sediment Management Standards (SMS) Sediment Quality Standard (SQS) and Cleanup Screening Level (CSL) (WAC 173-204). SQS are long-term cleanup goals that correspond to a sediment quality that will not result in adverse effects to biological resources. CSL are less stringent standards that correspond to minor adverse effects to biological resources; they are typically used to determine if remediation is required in a specific area.
- The SMS include TOC-normalized criteria for nonionic/nonpolar organic compounds. However, these criteria are generally only effective at predicting adverse effects in sediments with TOC content greater than 0.5 percent (Michelsen 1997). Also, in cases where high TOC (greater than 3 to 4 percent) may be due to some anthropogenic contribution (e.g., oils and wood debris), TOC normalization may not be appropriate. Where TOC exceeded 4 percent, concentrations of nonionic/nonpolar organic chemicals for these samples were compared with the Apparent Effects Threshold (AET) values (Barrick et al. 1988). The AET values are the functional equivalent of the SQS and CSL values, only they are expressed on a dry-weight basis. The lowest AET (LAET) was used as the equivalent of the SQS, and the second lowest AET (2LAET) was used in place of the CSL.

4.2.1.2 Porewater Screening Guidelines

- Federal marine chronic and acute Ambient Water Quality Criteria (AWQC; EPA 1995). As a requirement of the Clean Water Act (CWA), ambient water quality criteria have been published for the protection of aquatic organisms and human health (40 CFR 131). Acute values are designed to protect for short-term exposures to higher concentration, whereas chronic criteria address long-term exposures. While not promulgated standards, states and tribes are expected to adopt these criteria as their standards or develop criteria affording a similar degree of protectiveness.
- Washington State marine acute and chronic AWQC (WAC 173-201A). State water quality standards have been promulgated and incorporate the federal criteria in large measure.
- EPA proposed marine acute and chronic AWQC for tributyltin (TBT; EPA 1997). These guidelines are based on protection of most invertebrates and fishes, but do not protect for the most sensitive life stages or taxa.

These comparisons are only depicted in the graphical representations contained within Volume 2 of this report and are not discussed in the analytical results section. Summaries of the above screening guidelines, as well as other potentially applicable effects-based screening values, are provided in Appendix F.

4.2.2 Additional Evaluations of TBT Data

No standards are available for evaluating tributyltin in sediment. However, screening guidelines have been proposed for evaluation of TBT for use in several Puget Sound sediment management programs. The guidelines are based on partitioning theory and estimate a threshold sediment concentration based on an effects concentration in water. The following formula is used to calculate the sediment concentration of TBT:

$$[TBT]_{sed\ oc} = [TBT]_{pw} * K_{oc}$$

Where:

$[TBT]_{pw}$	=	Concentration of TBT in porewater (µg/L)
$[TBT]_{sed\ oc}$	=	Concentration of TBT in sediment (µg/kg oc)
K_{oc}	=	Organic carbon partition coefficient (L/kg)

For the purpose of this study, the PSDDA porewater screening guideline of 0.15 µg TBT/L was used to calculate a lower-end sediment screening concentration of 3,765 µg/kg oc, based on a K_{oc} of 25,100 (Meador et al. 1997). An upper-end sediment screening value was derived based on the marine acute water quality criterion and resulted in a concentration of 9,287 µg/kg oc. A TOC of 1 percent was used to calculate the dry weight equivalents for these screening concentrations.

4.3 ANALYTICAL RESULTS

4.3.1 Surface Sediment

4.3.1.1 Polychlorinated Biphenyls (PCBs)

PCBs were analyzed at all surface sediment sampling stations. Total PCBs were detected at 91 percent of these stations. Total PCB concentration averaged 334 µg/kg and ranged from 20 to 12,000 µg/kg dry-weight (DW). The highest measured total PCB concentration occurred in Reach C at station DR207. Aroclors 1254, 1260, and 1242 were the only PCB Aroclors detected. Aroclor 1254 was detected at 89 percent of the stations at concentrations ranging from 20 to 9,400 µg/kg DW. Aroclor 1260 was also frequently detected at 85 percent of the surface sediment stations. The highest measured concentration for Aroclors 1254 and 1260 occurred at station DR271 and DR207, respectively. Aroclor 1242 was infrequently detected at 13 percent of the stations. A statistical summary and complete listing of the PCB and PCB congener data are presented, as dry-weight concentrations, in Appendix E-1. A statistical summary and complete data listing of the TOC-normalized data can also be found in Appendix E-1. Map series 4-1 provides a graphical representation of the total PCB results for the entire waterway.

4.3.1.2 Base-Neutral Acid Extractables (BNAs)

BNAs were analyzed and detected at all surface sediment stations collected for this study. PAHs were most prevalent. Total high molecular weight PAHs (HPAHs) were encountered in

98 percent of the samples collected. Total HPAH concentration averaged 4,356 μg/kg and ranged from 20 to 50,840 μg/kg DW. The highest measured HPAH concentration was observed in Reach A at station DR044. Fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene were also ubiquitous throughout the waterway.

Total low molecular weight PAHs (LPAHs) and phenanthrene were detected at 97 percent of the surface sediment stations sampled. Total LPAH concentration averaged 791 μg/kg and ranged from 30 to 20,030 μg/kg DW. Phenanthrene averaged 514 μg/kg DW and ranged from 30 to 16,000 μg/kg DW. The highest measured concentration for LPAHs and phenanthrene occurred in Reach C at station DR175. Acenaphthene, fluorene, phenol, and hexachlorobenzene were also encountered in the waterway.

Bis(2-ethylhexyl) phthalate and butyl benzyl phthalate were detected at 74 and 64 percent of the surface sediment sampling stations, respectively. Bis(2-ethylhexyl) phthalate averaged 568 μg/kg, and ranged from 20 to 11,000 μg/kg DW. Butyl benzyl phthalate concentration averaged 47 μg/kg, with a range of 20 to 940 μg/kg DW. The highest concentrations of both analytes occurred at station DR008. A statistical summary and a complete listing of the BNA data are presented, as dry-weight concentrations, in Appendix E-2. A statistical summary and complete data listing of the TOC-normalized data can also be found in Appendix E-2. Map series 4-2 through 4-13 provides a graphical representation of these BNA results for the entire waterway.

4.3.1.3 Total Inorganics

Analytical results indicate that total inorganics were detected at all surface sediment sampling stations. Mercury was detected in 96 percent of the surface sediment samples collected for this study. The average mercury concentration was 0.18 mg/kg and ranged from 0.02 to 1.6 mg/kg DW. The highest mercury concentration occurred in Reach B at station DR157. Arsenic and zinc were also detected at all surface sediment stations. Maximum concentrations for both analytes occurred in Reach A at station DR020. The highest lead concentration was recorded in Reach D at station DR254. Appendix E-3 provides a statistical summary of the data and a complete data listing. Map series 4-14 through 4-17 provides a graphical representation of mercury, arsenic, lead, and zinc at selected reaches.

4.3.1.4 Pesticides

Pesticides were analyzed at 47 of the surface sediment sampling stations. Pesticides were infrequently detected with exception to 4,4’-dichloro-diphenyl-trichloroethene (4,4’-DDT) and its associated metabolites (i.e., 4,4’-DDD and 4,4’-DDE). 4,4’-DDT was detected in approximately 11 percent of those samples analyzed for this analyte. 4,4’-DDT had a mean concentration of 42 μg/kg and ranged from 2 to 1,670 μg/kg DW. The highest concentrations of 4,4’-DDT, 4,4’-DDD, and 4,4’-DDE were detected in Reach C at station DR178. Appendix E-1 provides a statistical summary of pesticide data and a complete listing of the data. Map series

4-18 through 4-20 provides a graphical representation of the 4,4'-DDT, 4,4'-DDD, and 4,4'-DDE results at selected reaches.

4.3.1.5 Dioxins/Furans

Analyses for dioxins/furans were conducted at 30 surface sediment sampling stations. Analytical results indicate that dioxins/furans were detected at all stations. For this study, total 2,3,7,8-TCDD (equivalence) was used as a measure of the relative toxicity of the various congeners identified. Total 2,3,7,8-TCDD (equivalence) had a mean concentration of 16 ng/kg, and ranged from below the method detection limit to 218 ng/kg DW. The highest concentration occurred in Reach B at DR123. Appendix E-4 provides a statistical summary and a complete listing of the data. Map series 4-21 provides a graphical representation of the total 2,3,7,8-TCDD results throughout the waterway.

4.3.1.6 Organotins

Organotins (reported as Organotin-ion) were analyzed at 92 of the surface sediment sampling stations. The most commonly detected organotin constituent was tri-n-butyltin (TBT), occurring in 92 percent of the samples analyzed for this analyte. TBT concentration averaged 70 µg/kg and ranged from 1 to 320 µg/kg DW, with the highest concentration identified at station DR002. Appendix E-5 provides a statistical summary of organotin data and a complete data listing. Map series 4-22 provides a graphical representation of the TBT results throughout the waterway.

4.3.1.7 Volatile Organic Compounds (VOCs)

VOCs were analyzed at 47 surface sediment sampling stations. VOCs were infrequently detected, with exception of 2-butanone. 2-Butanone was detected at 26 percent of the surface sediment stations sampled for this analyte. 2-Butanone concentrations averaged 30 µg/kg and ranged from 5 µg/kg to 35µg/kg DW. The highest measured concentration occurred at station DR154. Appendix E-6 provides a statistical summary and complete listing of the VOC data, as dry-weight concentrations.

4.3.1.8 Total Organic Carbon (TOC)

TOC analysis was performed at all surface sediment sampling stations. Analytical results indicate that TOC averaged 2.2 percent. TOC ranged from 0.1 to 9.2 percent, with the highest concentration measured at DR042. Appendix E-7 provides a statistical summary and a complete listing of the TOC data. Map series 4-23 provides a graphical representation of TOC results for the entire waterway.

4.3.1.9 Grain Size

Grain size analysis was performed at all surface sediment sampling stations. Sediments were characterized as coarse if the total fines fraction was less than 55 percent fines. Sediments identified as having 55 percent fines or greater were labeled as fine-grain sediments. As a result, the majority of stations sampled for this study were characterized as having fine-grain sediments. Analytical results indicate that stations averaged 65 percent total fines and 33 percent total sand. Total fines ranged from 1 to 97 percent, with the greatest percentage of fines occurring at station DR244. Total sands ranged from 3 to 99 percent. Station DR297 was identified as the station with the highest percentage of sands. Appendix E-7 provides a statistical summary and a complete listing of the grain size data. Map series 4-24 provides a graphical representation of grain size results for the entire waterway.

4.3.2 Subsurface Sediment

4.3.2.1 Polychlorinated Biphenyls

PCBs were analyzed at all of the subsurface sediment sampling stations. Total PCBs were detected at 76 percent of the subsurface stations analyzed and averaged 583 µg/kg, with a range of 37 to 4,043 µg/kg DW. The highest concentration was detected in Reach A at the 2- to 4-foot interval of station DR021. Aroclors 1254, 1260, and 1242 were the only PCB Aroclors detected. Aroclor 1254 was most frequently detected at 76 percent of the stations sampled. Concentrations of Aroclor 1254 ranged from 37 to 2,200 µg/kg, with the highest concentration measured at Reach A in the 0- to 2-foot interval of station DR068. Aroclor 1260 was also detected at many of the stations (73 percent) and ranged from 22 to 678 µg/kg DW. The maximum concentration of Aroclor 1260 was identified at the surface interval of station DR206 in Reach C. Aroclor 1242 was detected in 58 percent of the samples analyzed for this analyte. A statistical summary and complete listing of the PCB and PCB congener data are presented, as dry-weight concentrations, in Appendix E-8. A statistical summary and complete data listing of the TOC-normalized data can also be found in Appendix E-8. Map series 4-25 provides a graphical representation of total PCB results throughout the entire waterway.

4.3.2.2 Base-Neutral Acid Extractables

BNAs were analyzed at all subsurface sediment sampling stations and were frequently detected. Subsurface sediment results were similar to that of the surface, due to the prevalence of PAHs. Total HPAH and LPAH were detected in every core sampled. Total HPAH concentration averaged 3,095 µg/kg DW, with a range of 80 to 15,080 µg/kg. The highest total HPAH concentration was measured at the 2- to 4-foot interval of station DR054. Fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene were detected at this same station and interval.

Total LPAH and phenanthrene were detected at 100 percent of the subsurface samples collected. The total LPAH concentration averaged 411 µg/kg and ranged from 20 to 2,310 µg/kg DW. Phenanthrene averaged 252 µg/kg DW and ranged from 20 to 1,500 µg/kg. The highest measured concentration for LPAHs and phenanthrene occurred in Reach A at the 2- to 4-foot interval of station DR054. Acenaphthene, fluorene, phenol, and hexachlorobenzene were also encountered in the waterway.

Phthalates were frequently detected at subsurface stations, as well. Bis(2-ethylhexyl)phthalate and butyl benzyl phthalate were detected at 88 and 61 percent of the subsurface samples, respectively. Bis(2-ethylhexyl) averaged 741 µg/kg and ranged from 30 to 6,900 µg/kg DW. The maximum concentration was measured at the 0- to 2-foot interval of station DR008. Butyl benzyl phthalate ranged from 20 to 670 µg/kg, with an average concentration of 70 µg/kg DW. The highest measured concentration of butyl benzyl phthalate was observed at station DR008, 2 to 4 feet below the surface. A statistical summary and a complete listing of the BNA data are presented, as dry-weight concentrations, in Appendix E-9. A statistical summary and complete data listing of the TOC-normalized data can also be found in Appendix E-9. Map series 4-26 through 4-37 provides a graphical representation of these BNA results throughout the waterway and selected reaches.

4.3.2.3 Total Inorganics

Total inorganics were analyzed at all subsurface sediment sampling stations. Analytical results indicate that total inorganics were detected at all stations. Mercury was detected at 100 percent of the subsurface sediment samples collected for this study. The average mercury concentration was 0.30 mg/kg and ranged from 0.06 to 1.44 mg/kg DW. The highest measured concentration occurred at the 2- to 4-foot interval of station DR054 in Reach A. The highest concentrations of arsenic, lead, and zinc were also measured at DR054. Appendix E-10 provides a statistical summary and a complete listing of the total inorganic data. Map series 4-38 through 4-41 provides a graphical representation of mercury, arsenic, lead, and zinc at selected reaches.

4.3.2.4 Pesticides

Pesticides were analyzed at 8 of the subsurface sediment sampling stations. Pesticides were infrequently detected, with the exception of 4,4’-DDD and 4,4’-DDE. 4,4’-DDD was detected in 44 percent of the samples analyzed for this metabolite and ranged from 2 to 14 µg/kg DW. The highest concentration occurred at station DR008, 2 to 4 feet below the surface. 4,4’-DDE was detected at a frequency of 63 percent, with a range of 1 to 18 µg/kg DW. The highest 4,4’-DDE concentration was detected in Reach A at the 2- to 4-foot interval of station DR021. A statistical summary and complete data listing of the pesticide data, as dry-weight concentrations, are presented in Appendix E-8. Map series 4-42 through 4-44 provides a graphical representation of the 4,4’-DDT, 4,4’-DDD and 4,4’-DDE results at selected reaches.

4.3.2.5 Organotins

Organotins (reported as organotin-ion) were analyzed at 13 of the subsurface sediment sampling stations. The most commonly detected organotin was TBT, occurring in 80 percent of the samples analyzed for this analyte. TBT concentration averaged 235 µg/kg DW, and ranged from 3 to 2,500 µg/kg. The highest TBT concentration was measured at the surface interval of station DR054. Appendix E-11 provides a statistical summary and complete data listing of organotin data in subsurface sediments. Map series 4-45 provides a graphical representation of the TBT results throughout the waterway.

4.3.2.6 Total Organic Carbon

TOC analysis was performed at all subsurface sediment sampling stations. Analytical results indicate that TOC averaged 2.2 percent. TOC ranged from 0.8 to 3.6 percent, with the highest concentration measured at DR008. Appendix E-12 provides a statistical summary and complete data listing of the TOC data.

4.3.2.7 Grain Size

Grain size analysis was performed at all subsurface sediment sampling stations. Analytical results indicate that subsurface stations averaged 76 percent total fines and 23 percent total sand. Total fines ranged from 30 to 94 percent, with the greatest percentage of fines occurring at the 2- to 4-foot interval of stations DR044. Total sands ranged from 6 to 69 percent. The highest percentage of sands was identified at the 2- to 4-foot fraction of station DR269. Appendix E-12 provides a statistical summary and complete data listing of the grain size data.

4.3.3 Sediment Porewater Analysis

4.3.3.1 Total Inorganics

Total inorganics were analyzed at all surface sediment porewater stations. Analytical results indicate that total inorganics were detected at all stations. Arsenic was detected at 80 percent of the surface sediment porewater stations. Arsenic concentration averaged 53 µg/L and ranged from 26 to 114 µg/L. The highest measured concentration occurred at station DR244. Appendix E-13 provides a statistical summary and a complete data listing of the surface sediment porewater data. Map series 4-46 provides a graphical representation of surface sediment porewater results for arsenic throughout the entire waterway.

4.3.3.2 Organotins

Organotins were analyzed at all surface sediment porewater sampling stations. The most commonly detected organotin constituent was TBT; occurring in 53 percent of the samples analyzed for this analyte. Detected TBT concentrations ranged from less than the method detection limit to 0.08 µg/L, with the highest concentration measured at station DR055. Appendix E-14 provides a statistical summary and a complete data listing of organotin data in surface sediment porewater. Map series 4-47 provides a graphical representation of surface sediment porewater results for TBT throughout the entire waterway.

5. REFERENCES

SECTION 5

REFERENCES

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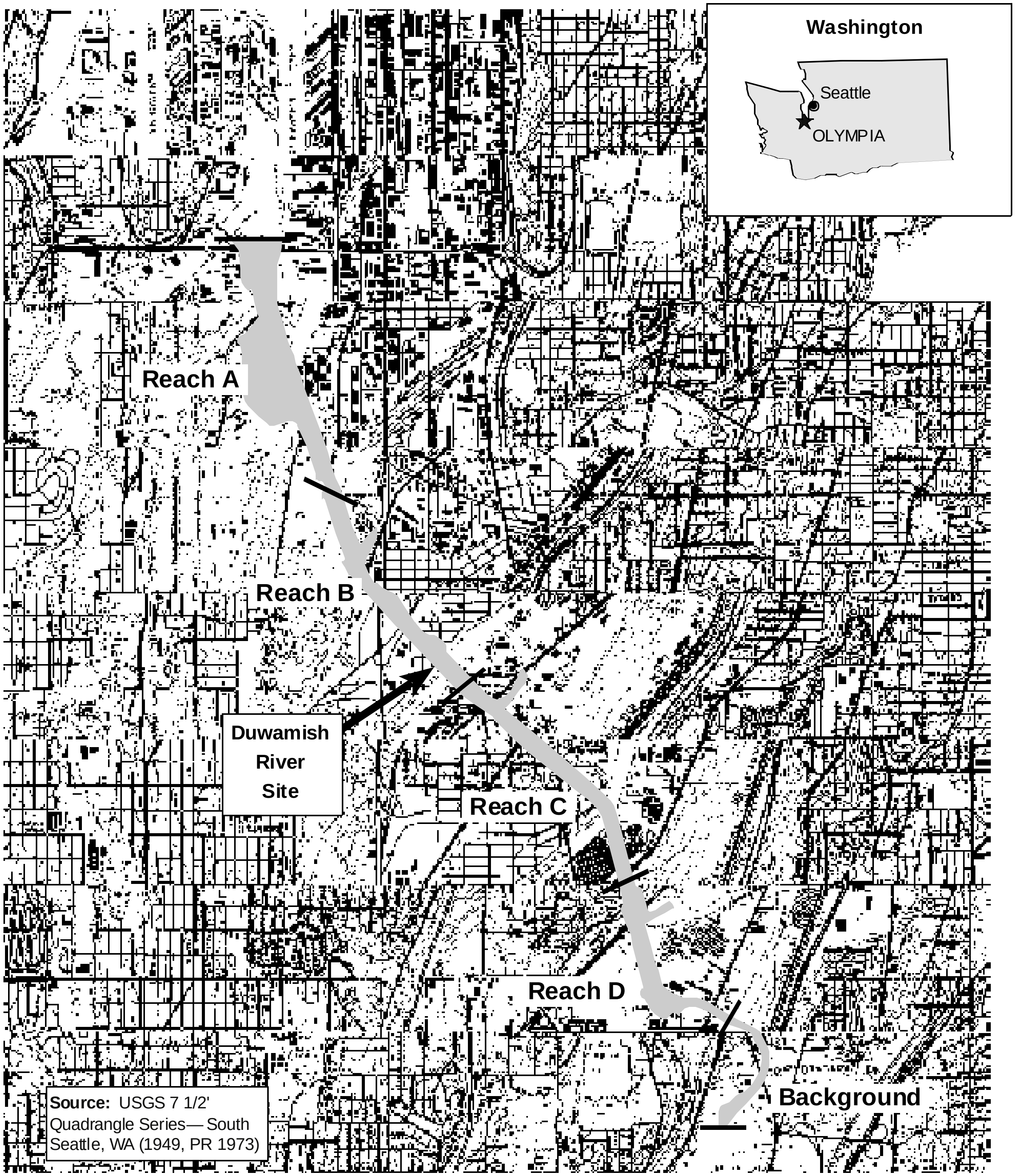
FIGURES



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0 2000 4000

Scale in Feet

WESTON

MANAGER DESIGNERS/CONSULTANTS

Duwamish River Site Inspection
Vicinity Map and Reach Locations

FIGURE
1-1

98-0404 Fig1-1.FH8

TABLES

Table 3-1—Surface Sediment Split Sampling Locations

Weston Sample ID	EPA Sample ID	Split Sample Provided To:
SD-DR095-0000	98344072	Lone Star
SD-DR097-0000	98344074	Lone Star
SD-DR098-0000	98344075	Lone Star
SD-DR099-0000	98344076	Lone Star
SD-DR176-0000	98364019	Boeing
SD-DR177-0000	98354003	Boeing
SD-DR178-0000	98354000	Boeing
SD-DR178-1000	98354001	Boeing
SD-DR179-0000	98354002	Boeing
SD-DR180-0000	98354004	Boeing
SD-DR181-0000	98364025	Boeing
PW-DR181-0000	98364038	Boeing
SD-DR182-0000	98354005	Boeing
SD-DR183-0000	98354006	Boeing
SD-DR242-0000	98354007	Boeing
SD-DR242-1000	98354008	Boeing
SD-DR241-0000	98354009	Boeing
SD-DR240-0000	98354011	Boeing
SD-DR243-0000	98354010	Boeing
SD-DR244-0000	98364024	Boeing
PW-DR244-0000	98364037	Boeing
SD-DR245-0000	98354012	Boeing
SD-DR246-0000	98364018	Boeing
SD-DR256-0000	98384016	Boeing
SD-DR257-0000	98384015	Boeing
SD-DR274-0000	98384018	Boeing
SD-DR275-0000	98384017	Boeing
SD-DR276-0000	98384014	Boeing
SD-DR294-0000	98384011	Boeing
SD-DR295-0000	98384012	Boeing
SD-DR296-0000	98384013	Boeing

Table 3-2—Subsurface Sediment Core Sampling Locations and Recovery Lengths

Station	Recovery Length (m)	Original Proposed Station[a]
Reach A		
DR008	1.1	
DR021	1.3	
DR025	1.3	
DR044	1.3	SD-DR046[b]
DR054	1.3	
DR068	0.70	
Reach B		
DR101	1.2	
DR106	1.0	SD-DR111[b]
DR112	1.3	
DR123[c]	--	
DR137	1.3	
DR137	1.4	
DR154[b]	--	
DR171	1.4	SD-DR142[b]
Reach C		
DR183[b]	--	
DR206	1.3	
DR220	1.4	SD-DR187[b]
DR224	1.0	
Reach D		
DR246	1.4	
DR269	1.4	SD-DR291[b]
DR284	1.4	

[a]As detailed in the Sampling and Analysis Plan (WESTON 1998)

[b]Location abandoned because of poor recovery and/or subsurface obstructions

[c]Sampling location abandoned as it could not be reached by the sampling vessel

Table 3-3—Deviation from Sampling and Analysis Plan

Sample Number	Modification	Justification for Deviation
SD-DR004-1000	Duplicate sample dropped	Consistent sediment over penetration
SD-DR029-0000	Station dropped	Inaccessible by boat
SD-DR065-0000	Organotin and dioxin analyses added	Compensate for SD-DR029-0000
SD-DR045-1000	Duplicate sample dropped	Insufficient sediment volume
SD-DR046-0000A	Sample replaced with SD-DR044-0000A; organotin analysis deleted	Insufficient core penetration @ DR046
SD-DR046-0020	Sample replaced with SD-DR044-0020; organotin analysis deleted	Insufficient core penetration @ DR046
SD-DR068-0020	Core sample dropped	Insufficient core penetration
SD-DR092-1000	Duplicate sample dropped; replaced with SD-DR111-1000; analyses unchanged	Consistent grab washout @ DR092
SD-DR142-0000	VOC, pesticide, organotin and dioxin analyses deleted	Insufficient sediment volume
SD-DR111-0000A	Sample replaced with SD-DR106-0000A; pesticide & organotin analysis deleted [a]	Insufficient core penetration @ DR111
SD-DR111-0020	Sample replaced with SD-DR106-0020; pesticide & organotin analysis deleted [a]	Insufficient core penetration @ DR111
SD-DR123-0000A	Station dropped	Inaccessible by core sampling vessel
SD-DR123-0020	Station dropped	Inaccessible by core sampling vessel
SD-DR139-0000A	Sample replaced with SD-DR137-0000A; analyses remain unchanged	Insufficient core penetration @ DR139
SD-DR139-0020	Sample replaced with SD-DR137-0020; analyses remain unchanged	Insufficient core penetration @ DR139
SD-DR139-1000A	Sample replaced with SD-DR137-1000A; analyses remain unchanged	Insufficient core penetration @ DR139
SD-DR139-1020	Sample replaced with SD-DR137-1020; analyses remain unchanged	Insufficient core penetration @ DR139
SD-DR142-0000A	Sample replaced with SD-DR171-0000A; pesticide analysis deleted [a]	Insufficient core penetration @ DR142
SD-DR142-0020	Sample replaced with SD-DR171-0020; pesticide analysis deleted [a]	Insufficient core penetration @ DR142
SD-DR154-0000A	Station dropped	Insufficient core penetration @ DR154
SD-DR154-0020	Station dropped	Insufficient core penetration @ DR154
SD-DR185-0000	VOC, pesticide, and organotin analyses deleted	Insufficient sediment volume
SD-DR185-1000	Duplicate sample dropped	Insufficient sediment volume
SD-DR186-0000	VOC, pesticide, and organotin analyses added	Compensate for SD-DR185-0000
SD-DR190-0000	Inadvertently dropped voc, pesticide, organotin and dioxin samples	N.A.
SD-DR221-0000	VOC, pesticide, organotin, and dioxin analyses added	Compensate for SD-DR190-0000
SD-DR183-0000A	Station dropped	Insufficient core penetration
SD-DR183-0020	Station dropped	Insufficient core penetration
SD-DR187-0000A	Sample replaced with SD-DR220-0000A; pesticide and organotin analyses deleted [a]	Insufficient core penetration @ DR187
SD-DR187-0020	Sample replaced with SD-DR220-0020; pesticide and organotin analyses deleted [a]	Insufficient core penetration @ DR187
SD-DR265-1000	Duplicate sample replaced with SD-DR286-1000; analyses unchanged	Insufficient sediment volume @ DR265
SD-DR291-0000A	Sample replaced with SD-DR269-0000A; pesticide and organotin analyses deleted [a]	Insufficient core penetration @ DR291
SD-DR291-0020	Sample replaced with SD-DR269-0020; pesticide and organotin analyses deleted [a]	Insufficient core penetration @ DR291

[a] Analyses were modified to coincide with co-located sediment analyses.

Table 3-4—Reach A Sampling Locations and Analyses

WESTON Sample ID	EPA Sample ID	Analysis							
		TAL Metals	BNA and PCB[a]	VOCs	Pesticides	Organotins	Dioxins	TOC	Grain Size
Surface Sediment									
SD-DR001-0000	98364023	X	X					X	X
SD-DR002-0000	98334002	X	X	X	X	X	X	X	X
SD-DR003-0000	98334001	X	X					X	X
SD-DR004-0000	98334000	X	X					X	X
SD-DR005-0000	98344022	X	X	X	X	X		X	X
SD-DR006-0000	98344023	X	X					X	X
SD-DR007-0000	98344024	X	X					X	X
SD-DR008-0000	98344025	X	X	X	X	X	X	X	X
SD-DR009-0000	98344026	X	X					X	X
SD-DR010-0000	98384000	X	X					X	X
SD-DR011-0000	98344028	X	X	X	X	X		X	X
SD-DR012-0000	98344030	X	X					X	X
SD-DR013-0000	98344031	X	X					X	X
SD-DR014-0000	98344033	X	X					X	X
SD-DR015-0000	98344000	X	X					X	X
SD-DR016-0000	98344001	X	X					X	X
SD-DR017-0000	98344002	X	X					X	X
SD-DR018-0000	98364031	X	X			X		X	X
PW-DR018-0000	**98364044**	**X**				**X**			
SD-DR019-0000	98344004	X	X					X	X
SD-DR020-0000	98344003	X	X					X	X
SD-DR021-0000	98344005	X	X	X	X	X	X	X	X
SD-DR022-0000	98344006	X	X					X	X
SD-DR022-1000	98344007	X	X					X	X
SD-DR023-0000	98344008	X	X					X	X
SD-DR024-0000	98344011	X	X					X	X
SD-DR025-0000	98344012	X	X	X	X	X		X	X
SD-DR026-0000	98344013	X	X					X	X
SD-DR027-0000	98344014	X	X					X	X
SD-DR028-0000	98344015	X	X					X	X
SD-DR030-0000	98344018	X	X					X	X
SD-DR031-0000	98334004	X	X					X	X
SD-DR032-0000	98334003	X	X					X	X
SD-DR033-0000	98334005	X	X	X	X	X	X	X	X
SD-DR034-0000	98334007	X	X					X	X
SD-DR035-0000	98334006	X	X					X	X
SD-DR036-0000	98334008	X	X					X	X
SD-DR037-0000	98344036	X	X					X	X
SD-DR038-0000	98364030	X	X			X		X	X
PW-DR038-0000	**98364043**	**X**				**X**			
SD-DR039-0000	98334009	X	X					X	X
SD-DR040-0000	98334010	X	X					X	X
SD-DR041-0000	98334014	X	X					X	X
SD-DR042-0000	98334012	X	X	X	X	X	X	X	X
SD-DR043-0000	98334011	X	X					X	X
SD-DR044-0000	98334013	X	X					X	X
SD-DR045-0000	98384009	X	X					X	X
SD-DR046-0000	98334019	X	X			X	X	X	X
SD-DR047-0000	98384008	X	X	X	X	X	X	X	X
SD-DR048-0000	98334018	X	X					X	X
SD-DR049-0000	98334022	X	X			X		X	X
SD-DR050-0000	98364010	X	X					X	X
SD-DR051-0000	98334024	X	X			X	X	X	X

Table 3-4—Reach A Sampling Locations and Analyses

WESTON Sample ID	EPA Sample ID	Analysis: TAL Metals	BNA and PCB[a]	VOCs	Pesticides	Organotins	Dioxins	TOC	Grain Size
SD-DR052-0000	98334026	X	X					X	X
SD-DR053-0000	98364011	X	X	X	X	X		X	X
SD-DR053-1000	98364012	X	X	X	X	X		X	X
SD-DR054-0000	98334030	X	X			X		X	X
SD-DR055-0000	98364035	X	X			X		X	X
PW-DR055-0000	**98364049**	**X**				**X**			
SD-DR056-0000	98364000	X	X			X		X	X
SD-DR057-0000	98364001	X	X					X	X
SD-DR058-0000	98364002	X	X					X	X
SD-DR059-0000	98344027	X	X					X	X
SD-DR060-0000	98344029	X	X					X	X
SD-DR061-0000	98344032	X	X					X	X
SD-DR062-0000	98344009	X	X					X	X
SD-DR063-0000	98344010	X	X					X	X
SD-DR064-0000	98344016	X	X					X	X
SD-DR065-0000	98344017	X	X			X	X	X	X
SD-DR066-0000	98344034	X	X					X	X
SD-DR067-0000	98344035	X	X	X	X	X		X	X
SD-DR068-0000	98344037	X	X			X		X	X
SD-DR069-0000	98334015	X	X					X	X
SD-DR069-1000	98334016	X	X					X	X
SD-DR070-0000	98334017	X	X			X		X	X
SD-DR071-0000	98344038	X	X					X	X
SD-DR072-0000	98334020	X	X			X		X	X
SD-DR073-0000	98334021	X	X					X	X
SD-DR074-0000	98334025	X	X					X	X
SD-DR075-0000	98334027	X	X					X	X
SD-DR076-0000	98354013	X	X					X	X
SD-DR077-0000	98354017	X	X					X	X
SD-DR078-0000	98354016	X	X					X	X
SD-DR079-0000	98354015	X	X					X	X
SD-DR080-0000	98354014	X	X					X	X
SD-DR081-0000	98364003	X	X	X	X	X		X	X
SD-DR082-0000	98364004	X	X					X	X
SD-DR083-0000	98364005	X	X					X	X
SD-DR084-0000	98364006	X	X					X	X
SD-DR085-0000	98364007	X	X					X	X
SD-DR086-0000	98364008	X	X					X	X
SD-DR087-0000	98334023	X	X	X	X	X		X	X
SD-DR088-0000	98364009	X	X					X	X
SD-DR089-0000	98334028	X	X					X	X
SD-DR090-0000	98334029	X	X			X		X	X

Porewater sample (shaded)

[a]Analyzed for both Aroclors and Congeners

Table 3-5—Reach B Sampling Locations and Analyses

WESTON Sample ID	EPA Sample ID	Analysis							
		TAL Metals	BNA and PCB[a]	VOCs	Pesticides	Organotins	Dioxins	TOC	Grain Size
Surface Sediment									
SD-DR091-0000	98364013	X	X					X	X
SD-DR092-0000	98354085	X	X	X	X	X	X	X	X
SD-DR093-0000	98344020	X	X					X	X
SD-DR094-0000	98344073	X	X					X	X
SD-DR095-0000	98344072	X	X					X	X
SD-DR096-0000	98364032	X	X			X		X	X
PW-DR096-0000	**98364045**	**X**				**X**			
PW-DR096-1000	**98364046**	**X**				**X**			
SD-DR097-0000	98344074	X	X					X	X
SD-DR098-0000	98344075	X	X					X	X
SD-DR099-0000	98344076	X	X					X	X
SD-DR100-0000	98344077	X	X					X	X
SD-DR101-0000	98344078	X	X	X	X	X	X	X	X
SD-DR102-0000	98344079	X	X					X	X
SD-DR103-0000	98344039	X	X					X	X
SD-DR104-0000	98344040	X	X					X	X
SD-DR105-0000	98344057	X	X					X	X
SD-DR106-0000	98344054	X	X					X	X
SD-DR107-0000	98344053	X	X					X	X
SD-DR108-0000	98344052	X	X					X	X
SD-DR109-0000	98364029	X	X			X		X	X
PW-DR109-0000	**98364042**	**X**				**X**			
SD-DR110-0000	98344051	X	X			X		X	X
SD-DR111-0000	98344055	X	X	X	X	X	X	X	X
SD-DR111-1000	98344056	X	X	X	X	X		X	X
SD-DR112-0000	98344050	X	X			X		X	X
SD-DR113-0000	98344058	X	X					X	X
SD-DR113-1000	98344059	X	X					X	X
SD-DR114-0000	98344060	X	X					X	X
SD-DR115-0000	98384003	X	X			X	X	X	X
SD-DR116-0000	98344043	X	X	X	X	X		X	X
SD-DR117-0000	98344044	X	X					X	X
SD-DR118-0000	98344045	X	X					X	X
SD-DR119-0000	98344046	X	X					X	X
SD-DR120-0000	98334031	X	X					X	X
SD-DR121-0000	98364014	X	X			X		X	X
SD-DR122-0000	98384001	X	X					X	X
SD-DR123-0000	98384002	X	X	X	X	X	X	X	X
SD-DR124-0000	98384010	X	X					X	X
SD-DR125-0000	98364015	X	X					X	X
SD-DR126-0000	98334033	X	X					X	X
SD-DR127-0000	98334034	X	X					X	X
SD-DR128-0000	98334035	X	X					X	X
SD-DR129-0000	98354082	X	X					X	X
SD-DR130-0000	98334036	X	X					X	X
SD-DR131-0000	98334038	X	X					X	X
SD-DR131-1000	98334039	X	X					X	X
SD-DR132-0000	98334041	X	X					X	X
SD-DR133-0000	98364034	X	X			X		X	X
PW-DR133-0000	**98364048**	**X**				**X**			
SD-DR134-0000	98334044	X	X					X	X

Table 3-5—Reach B Sampling Locations and Analyses

WESTON Sample ID	EPA Sample ID	Analysis: TAL Metals	BNA and PCB[a]	VOCs	Pesticides	Organotins	Dioxins	TOC	Grain Size
SD-DR135-0000	98334046	X	X					X	X
SD-DR136-0000	98334048	X	X			X		X	X
SD-DR137-0000	98334050	X	X					X	X
SD-DR138-0000	98364022	X	X					X	X
SD-DR139-0000	98384004	X	X	X	X			X	X
SD-DR140-0000	98364028	X	X			X		X	X
PW-DR140-0000	**98364041**	**X**				**X**			
SD-DR141-0000	98344080	X	X					X	X
SD-DR141-1000	98344081	X	X					X	X
SD-DR142-0000	98344183	X	X					X	X
SD-DR143-0000	98364020	X	X					X	X
SD-DR144-0000	98344019	X	X					X	X
SD-DR145-0000	98344021	X	X					X	X
SD-DR146-0000	98344071	X	X					X	X
SD-DR147-0000	98364033	X	X			X		X	X
PW-DR147-0000	**98364047**	**X**				**X**			
SD-DR148-0000	98344041	X	X					X	X
SD-DR149-0000	98344061	X	X					X	X
SD-DR150-0000	98344042	X	X					X	X
SD-DR151-0000	98344047	X	X			X		X	X
SD-DR152-0000	98354086	X	X	X	X	X		X	X
SD-DR153-0000	98364017	X	X					X	X
SD-DR154-0000	98334037	X	X	X	X	X	X	X	X
SD-DR155-0000	98334042	X	X					X	X
SD-DR156-0000	98334049	X	X					X	X
SD-DR157-0000	98364021	X	X					X	X
SD-DR158-0000	98344082	X	X					X	X
SD-DR159-0000	98334053	X	X					X	X
SD-DR160-0000	98334032	X	X					X	X
SD-DR161-0000	98364016	X	X					X	X
SD-DR162-0000	98354084	X	X					X	X
SD-DR163-0000	98354083	X	X	X	X	X		X	X
SD-DR164-0000	98344070	X	X					X	X
SD-DR165-0000	98334040	X	X					X	X
SD-DR166-0000	98334043	X	X			X		X	X
SD-DR167-0000	98334045	X	X					X	X
SD-DR168-0000	98334047	X	X	X	X	X	X	X	X
SD-DR169-0000	98334051	X	X					X	X
SD-DR170-0000	98334052	X	X					X	X
SD-DR171-0000	98344069	X	X			X		X	X

Porewater sample

[a]Analyzed for both Aroclors and Congeners

Table 3-6—Reach C Sampling Locations and Analyses

WESTON Sample ID	EPA Sample ID	Analysis							
		TAL Metals	BNA and PCB[a]	VOCs	Pesticides	Organotins	Dioxins	TOC	Grain Size
Surface Sediment									
SD-DR172-0000	98344048	X	X					X	X
SD-DR173-0000	98344049	X	X					X	X
SD-DR174-0000	98344098	X	X			X		X	X
SD-DR175-0000	98344097	X	X					X	X
SD-DR176-0000	98364019	X	X					X	X
SD-DR177-0000	98354003	X	X					X	X
SD-DR178-0000	98354000	X	X	X	X	X		X	X
SD-DR178-1000	98354001	X	X	X	X	X		X	X
SD-DR179-0000	98354002	X	X					X	X
SD-DR180-0000	98354004	X	X					X	X
SD-DR181-0000	98364025	X	X			X		X	X
PW-DR181-0000	**98364038**	**X**				**X**			
SD-DR182-0000	98354005	X	X					X	X
SD-DR183-0000	98354006	X	X	X	X	X	X	X	X
SD-DR184-0000	98344066	X	X					X	X
SD-DR185-0000	98354073	X	X					X	X
SD-DR186-0000	98354072	X	X	X	X	X		X	X
SD-DR187-0000	98354070	X	X	X	X	X	X	X	X
SD-DR188-0000	98354029	X	X					X	X
SD-DR189-0000	98384005	X	X					X	X
SD-DR190-0000	98334055	X	X					X	X
SD-DR191-0000	98334061	X	X					X	X
SD-DR192-0000	98334057	X	X	X	X	X		X	X
SD-DR193-0000	98334059	X	X					X	X
SD-DR194-0000	98344086	X	X			X		X	X
SD-DR195-0000	98344089	X	X					X	X
SD-DR196-0000	98344090	X	X					X	X
SD-DR197-0000	98344092	X	X					X	X
SD-DR198-0000	98344094	X	X					X	X
SD-DR199-0000	98344095	X	X			X		X	X
SD-DR200-0000	98344096	X	X					X	X
SD-DR201-0000	98354064	X	X					X	X
SD-DR202-0000	98354081	X	X					X	X
SD-DR203-0000	98354066	X	X	X	X	X	X	X	X
SD-DR204-0000	98354080	X	X					X	X
SD-DR205-0000	98354078	X	X					X	X
SD-DR206-0000	98354077	X	X	X	X	X	X	X	X
SD-DR207-0000	98354076	X	X					X	X
SD-DR208-0000	98354074	X	X			X		X	X
SD-DR209-0000	98354071	X	X					X	X
SD-DR210-0000	98354031	X	X			X		X	X
SD-DR211-0000	98354030	X	X					X	X
SD-DR212-0000	98344084	X	X					X	X
SD-DR213-0000	98344085	X	X					X	X
SD-DR214-0000	98344062	X	X					X	X
SD-DR215-0000	98344063	X	X			X		X	X
SD-DR216-0000	98344099	X	X					X	X
SD-DR217-0000	98344065	X	X	X	X	X		X	X
SD-DR218-0000	98344064	X	X					X	X
SD-DR219-0000	98384007	X	X					X	X

Table 3-6—Reach C Sampling Locations and Analyses

WESTON Sample ID	EPA Sample ID	Analysis							
		TAL Metals	BNA and PCB[a]	VOCs	Pesticides	Organotins	Dioxins	TOC	Grain Size
SD-DR220-0000	98354033	X	X					X	X
SD-DR221-0000	98334056	X	X	X	X	X	X	X	X
SD-DR222-0000	98334058	X	X					X	X
SD-DR223-0000	98344087	X	X					X	X
SD-DR223-1000	98344088	X	X					X	X
SD-DR224-0000	98344091	X	X	X	X	X	X	X	X
SD-DR225-0000	98344093	X	X					X	X
SD-DR226-0000	98354065	X	X					X	X
SD-DR227-0000	98354079	X	X					X	X
SD-DR228-0000	98364027	X	X			X		X	X
PW-DR228-0000	**98364040**	**X**				**X**			
SD-DR229-0000	98354075	X	X					X	X
SD-DR230-0000	98354032	X	X					X	X
SD-DR231-0000	98334054	X	X					X	X
SD-DR232-0000	98334060	X	X			X		X	X
SD-DR233-0000	98344068	X	X					X	X
SD-DR234-0000	98344067	X	X			X		X	X
SD-DR235-0000	98354063	X	X					X	X

Porewater sample

[a]Analyzed for both Aroclors and Congeners

Table 3-7—Reach D Sampling Locations and Analyses

WESTON Sample ID	EPA Sample ID	Analysis							
		TAL Metals	BNA and PCB[a]	VOCs	Pesticides	Organotins	Dioxins	TOC	Grain Size
Surface Sediment									
SD-DR236-0000	98354069	X	X					X	X
SD-DR237-0000	98354025	X	X					X	X
SD-DR238-0000	98354067	X	X	X	X	X	X	X	X
SD-DR239-0000	98354068	X	X					X	X
SD-DR240-0000	98354011	X	X					X	X
SD-DR241-0000	98354009	X	X					X	X
SD-DR242-0000	98354007	X	X	X	X	X		X	X
SD-DR242-1000	98354008	X	X	X	X	X		X	X
SD-DR243-0000	98354010	X	X					X	X
SD-DR244-0000	98364024	X	X			X		X	X
PW-DR244-0000	**98364037**	**X**				**X**			
SD-DR245-0000	98354012	X	X					X	X
SD-DR246-0000	98364018	X	X			X	X	X	X
SD-DR247-0000	98354059	X	X					X	X
SD-DR248-0000	98354058	X	X					X	X
SD-DR249-0000	98354052	X	X	X	X	X		X	X
SD-DR250-0000	98354050	X	X					X	X
SD-DR251-0000	98354043	X	X			X		X	X
SD-DR252-0000	98354038	X	X					X	X
SD-DR253-0000	98354037	X	X			X		X	X
SD-DR254-0000	98354036	X	X					X	X
SD-DR255-0000	98384019	X	X					X	X
SD-DR256-0000	98384016	X	X	X	X	X	X	X	X
SD-DR257-0000	98384015	X	X					X	X
SD-DR258-0000	98354026	X	X	X	X	X		X	X
SD-DR259-0000	98354023	X	X					X	X
SD-DR260-0000	98364036	X	X			X		X	X
PW-DR260-0000	**98364050**	**X**				**X**			
SD-DR261-0000	98354021	X	X					X	X
SD-DR262-0000	98364026	X	X			X		X	X
PW-DR262-0000	**98364039**	**X**				**X**			
SD-DR263-0000	98354018	X	X					X	X
SD-DR264-0000	98354056	X	X			X	X	X	X
SD-DR265-0000	98354053	X	X					X	X
SD-DR266-0000	98354049	X	X	X	X	X		X	X
SD-DR267-0000	98354042	X	X					X	X
SD-DR268-0000	98354041	X	X					X	X
SD-DR269-0000	98354040	X	X					X	X
SD-DR270-0000	98354039	X	X			X		X	X
SD-DR271-0000	98384020	X	X					X	X
SD-DR272-0000	98354034	X	X					X	X
SD-DR273-0000	98354035	X	X			X		X	X
SD-DR274-0000	98384018	X	X					X	X
SD-DR275-0000	98384017	X	X					X	X
SD-DR276-0000	98384014	X	X					X	X
SD-DR277-0000	98354027	X	X					X	X
SD-DR278-0000	98354062	X	X					X	X
SD-DR279-0000	98354061	X	X					X	X
SD-DR280-0000	98354057	X	X					X	X
SD-DR281-0000	98354051	X	X					X	X
SD-DR282-0000	98354028	X	X					X	X

Table 3-7—Reach D Sampling Locations and Analyses

WESTON Sample ID	EPA Sample ID	Analysis: TAL Metals	BNA and PCB[a]	VOCs	Pesticides	Organotins	Dioxins	TOC	Grain Size
SD-DR283-0000	98354022	X	X					X	X
SD-DR284-0000	98354020	X	X	X	X	X	X	X	X
SD-DR285-0000	98354019	X	X					X	X
SD-DR286-0000	98354054	X	X					X	X
SD-DR286-1000	98354055	X	X					X	X
SD-DR287-0000	98354048	X	X					X	X
SD-DR288-0000	98354024	X	X			X		X	X
SD-DR289-0000	98354060	X	X	X	X	X		X	X
SD-DR290-0000	98354047	X	X					X	X
SD-DR291-0000	98354046	X	X	X	X	X	X	X	X
SD-DR292-0000	98354044	X	X					X	X
SD-DR292-1000	98354045	X	X					X	X
SD-DR293-0000	98384006	X	X					X	X
SD-DR294-0000	98384011	X	X					X	X
SD-DR295-0000	98384012	X	X					X	X
SD-DR296-0000	98384013	X	X					X	X
SD-DR297-0000	98384021	X	X	X	X	X		X	X
SD-DR298-0000	98384022	X	X	X	X	X	X	X	X
PW-DR298-0000	**98384026**	**X**				**X**			
SD-DR299-0000	98384024	X	X	X	X	X		X	X
SD-DR300-0000	98384025	X	X	X	X	X		X	X
SD-DR301-0000	98384023	X	X	X	X	X	X	X	X
PW-DR301-0000	**98384027**	**X**				**X**			

Porewater sample (shaded rows)

[a]Analyzed for both Aroclors and Congeners

Table 3-8—Subsurface Sediment Core Sample Analyses

		Analysis					
WESTON Sample ID	EPA Sample ID	TAL Metals	BNA and PCB[a]	Pesticides	Organotins	TOC	Grain Size
Reach A							
SD-DR008-0000A	98394014	X	X	X	X	X	X
SD-DR008-0020	98394015	X	X	X	X	X	X
SD-DR021-0000A	98394012	X	X	X	X	X	X
SD-DR021-0020	98394013	X	X	X	X	X	X
SD-DR025-0000A	98394010	X	X	X	X	X	X
SD-DR025-0020	98394011	X	X	X	X	X	X
SD-DR044-0000A	98394023	X	X			X	X
SD-DR044-0020	98394024	X	X			X	X
SD-DR054-0000A	98394008	X	X		X	X	X
SD-DR054-0020	98394009	X	X		X	X	X
SD-DR068-0000A	98394016	X	X		X	X	X
Reach B							
SD-DR101-0000A	98394006	X	X	X	X	X	X
SD-DR101-0020	98394007	X	X	X	X	X	X
SD-DR106-0000A	98394004	X	X			X	X
SD-DR106-0020	98394005	X	X			X	X
SD-DR112-0000A	98394002	X	X		X	X	X
SD-DR112-0020	98394003	X	X		X	X	X
SD-DR137-0000A	98394027	X	X	X	X	X	X
SD-DR137-0020	98394028	X	X	X	X	X	X
SD-DR137-1000A	98394029	X	X	X	X	X	X
SD-DR137-1020	98394030	X	X	X	X	X	X
SD-DR171-0000A	98394033	X	X		X	X	X
SD-DR171-0020	98394034	X	X		X	X	X
Reach C							
SD-DR220-0000A	98394031	X	X			X	X
SD-DR220-0020	98394032	X	X			X	X
SD-DR206-0000A	98394021	X	X	X	X	X	X
SD-DR206-0020	98394022	X	X	X	X	X	X
SD-DR224-0000A	98394000	X	X	X	X	X	X
SD-DR224-0020	98394001	X	X	X	X	X	X
Reach D							
SD-DR246-0000A	98394017	X	X		X	X	X
SD-DR246-0020	98394018	X	X		X	X	X
SD-DR269-0000A	98394025	X	X			X	X
SD-DR269-0020	98394026	X	X			X	X
SD-DR284-0000A	98394019	X	X	X	X	X	X
SD-DR284-0020	98394020	X	X	X	X	X	X

[a] Analyzed for both Aroclors and congeners.

APPENDIX A

SURFACE SEDIMENT RECORD FORMS

APPENDIX B

CORE LOG DESCRIPTION

APPENDIX C

STATION COORDINATES

Table C-1—Duwamish River X & Y Coordinates by Station

Station	EPA Sample	N*	W*	X-Coordinate	Y-Coordinate
DR001	98364023	47 34 08.01	122 20 43.86	1267138.3490	211182.0841
DR002	98334002	47 34 04.83	122 20 45.80	1266999.0100	210862.5517
DR003	98334001	47 34 01.81	122 20 47.17	1266899.0650	210558.4604
DR004	98334000	47 33 58.73	122 20 46.74	1266922.4120	210245.8643
DR005	98344022	47 33 54.53	122 20 47.09	1266890.0480	209820.8593
DR006	98344023	47 33 51.79	122 20 46.80	1266904.4740	209542.8953
DR007	98344024	47 33 48.72	122 20 45.72	1266972.4110	209230.4361
DR008	98344025	47 33 47.02	122 20 44.78	1267033.4790	209056.9522
DR009	98344026	47 33 45.96	122 20 43.28	1267134.2200	208947.5486
DR010	98384000	47 33 42.08	122 20 42.14	1267204.6660	208552.9531
DR011	98344028	47 33 39.71	122 20 43.14	1267131.3790	208314.2098
DR012	98344030	47 33 34.86	122 20 39.96	1267339.7830	207818.6016
DR013	98344031	47 33 32.57	122 20 38.51	1267434.6580	207584.6630
DR014	98344033	47 33 29.08	122 20 37.09	1267525.0920	207229.2002
DR015	98344000	47 33 25.74	122 20 33.92	1267735.8350	206886.5791
DR016	98344001	47 33 25.35	122 20 31.64	1267891.4120	206844.0040
DR017	98344002	47 33 25.37	122 20 26.15	1268267.9310	206838.6518
DR018	98364031	47 33 24.09	122 20 27.41	1268178.9850	206710.6752
DR019	98344004	47 33 22.31	122 20 27.00	1268203.5690	206529.8030
DR020	98344003	47 33 22.55	122 20 23.41	1268450.2350	206549.2943
DR021	98344005	47 33 24.09	122 20 32.62	1267821.7040	206717.6787
DR022	98344006	47 33 19.28	122 20 30.82	1267935.5880	206227.9855
DR023	98344008	47 33 15.93	122 20 28.84	1268064.7210	205885.9551
DR024	98344011	47 33 13.42	122 20 27.71	1268137.2330	205630.1631
DR025	98344012	47 33 11.32	122 20 26.30	1268229.7630	205415.5299
DR026	98344013	47 33 08.65	122 20 25.55	1268275.9010	205144.0403
DR027	98344014	47 33 06.46	122 20 24.46	1268346.3110	204920.7202
DR028	98344015	47 33 03.39	122 20 22.56	1268470.5290	204607.1651
DR030	98344018	47 33 01.71	122 20 21.77	1268521.3790	204435.9135
DR031	98334004	47 34 10.36	122 21 07.49	1265522.9800	211452.0555
DR032	98334003	47 34 05.31	122 21 00.25	1266009.2620	210930.6801
DR033	98334005	47 34 02.09	122 20 59.32	1266066.5950	210603.2247
DR034	98334007	47 34 00.78	122 20 59.35	1266061.9230	210470.5571
DR035	98334006	47 33 58.06	122 20 58.66	1266103.8010	210194.0781
DR036	98334008	47 33 54.91	122 20 56.70	1266231.8990	209872.3230
DR037	98344036	47 33 52.78	122 20 55.07	1266339.4100	209654.3444
DR038	98364030	47 33 49.37	122 20 53.75	1266423.1160	209307.1157
DR039	98334009	47 33 46.50	122 20 54.11	1266392.7070	209016.8594
DR040	98334010	47 33 43.54	122 20 57.28	1266169.4400	208721.2806
DR041	98334014	47 33 41.85	122 20 53.75	1266408.1170	208545.3100
DR042	98334012	47 33 38.55	122 20 58.25	1266092.9680	208217.0845
DR043	98334011	47 33 36.00	122 20 56.25	1266225.0210	207956.0577
DR044	98334013	47 33 38.63	122 20 51.19	1266577.2360	208215.6560
DR045	98384009	47 33 30.55	122 20 59.59	1265985.1100	207408.4639
DR046	98334019	47 33 30.98	122 20 47.85	1266791.0200	207436.1748
DR047	98384008	47 33 23.63	122 20 54.59	1266314.1740	206700.6860
DR048	98334018	47 33 20.83	122 20 44.56	1266996.4170	206403.5033
DR049	98334022	47 33 19.58	122 20 37.80	1267457.5120	206267.7672
DR050	98364010	47 33 17.65	122 20 36.96	1267511.2800	206071.1197

Table C-1—Duwamish River X & Y Coordinates by Station

Station	EPA Sample	N*	W*	X-Coordinate	Y-Coordinate
DR051	98334024	47 33 14.03	122 20 34.43	1267677.5890	205700.9942
DR052	98334026	47 33 10.08	122 20 32.73	1267786.3260	205298.5561
DR053	98364011	47 33 06.26	122 20 30.36	1267941.2770	204908.3874
DR054	98334030	47 33 04.50	122 20 28.38	1268073.5770	204727.4305
DR055	98364035	47 34 06.55	122 20 51.37	1266620.5540	211044.3060
DR056	98364000	47 34 02.70	122 20 50.92	1266643.7320	210653.6785
DR057	98364001	47 33 53.79	122 20 49.49	1266724.0180	209749.1309
DR058	98364002	47 33 51.00	122 20 48.89	1266759.5980	209465.6835
DR059	98344027	47 33 44.01	122 20 43.77	1267096.7400	208750.6660
DR060	98344029	47 33 37.36	122 20 43.26	1267118.4720	208076.3070
DR061	98344032	47 33 30.79	122 20 38.50	1267431.8030	207404.3283
DR062	98344009	47 33 19.37	122 20 32.46	1267823.2990	206239.3082
DR063	98344010	47 33 15.40	122 20 29.30	1268032.1220	205832.8821
DR064	98344016	47 33 05.84	122 20 25.20	1268294.3300	204858.9055
DR065	98344017	47 33 00.50	122 20 22.74	1268452.4530	204314.6377
DR066	98344034	47 34 02.05	122 20 56.87	1266234.4920	210595.8628
DR067	98344035	47 33 55.25	122 20 55.94	1266284.6870	209905.7399
DR068	98344037	47 33 52.00	122 20 54.11	1266403.6770	209574.0312
DR069	98344015	47 33 47.47	122 20 51.56	1266569.4890	209111.6824
DR070	98334017	47 33 41.66	122 20 49.60	1266692.3010	208520.4618
DR071	98344038	47 33 33.36	122 20 44.88	1266999.4220	207673.2740
DR072	98334020	47 33 30.41	122 20 42.70	1267143.0380	207371.4894
DR073	98334021	47 33 21.76	122 20 38.36	1267423.4440	206489.3640
DR074	98334025	47 33 15.00	122 20 34.25	1267691.8610	205799.0170
DR075	98334027	47 33 08.91	122 20 29.83	1267982.8880	205176.1308
DR076	98354013	47 34 08.06	122 21 00.52	1265996.2430	211209.6307
DR077	98354017	47 34 03.66	122 20 57.71	1266180.1140	210760.0967
DR078	98354016	47 33 59.12	122 20 55.98	1266289.6660	210297.8402
DR079	98354015	47 33 54.83	122 20 53.27	1266466.9160	209859.5875
DR080	98354014	47 33 49.94	122 20 50.94	1266616.9240	209361.0667
DR081	98364003	47 33 45.93	122 20 47.93	1266815.3200	208950.7775
DR082	98364004	47 33 41.99	122 20 46.64	1266895.9240	208549.9003
DR083	98364005	47 33 34.64	122 20 44.13	1267053.4000	207801.9324
DR084	98364006	47 33 31.03	122 20 41.48	1267227.9320	207432.6543
DR085	98364007	47 33 27.33	122 20 38.98	1267392.0060	207054.4624
DR086	98364008	47 33 21.06	122 20 35.47	1267620.2400	206414.5613
DR087	98334023	47 33 18.68	122 20 33.73	1267734.8350	206171.1165
DR088	98364009	47 33 12.17	122 20 30.26	1267959.8720	205506.9603
DR089	98334028	47 33 10.01	122 20 28.57	1268071.4850	205285.8717
DR090	98334029	47 33 04.74	122 20 25.94	1268241.3960	204748.4649
DR091	98364013	47 32 57.37	122 20 19.57	1268663.6630	203993.3007
DR092	98354085	47 32 52.91	122 20 18.23	1268746.7300	203539.6860
DR093	98344020	47 32 50.35	122 20 16.66	1268849.3420	203278.2413
DR094	98344073	47 32 46.74	122 20 13.58	1269053.4470	202908.4033
DR095	98344072	47 32 46.03	122 20 12.09	1269154.2400	202834.4803
DR096	98364032	47 32 48.59	122 20 09.04	1269368.5040	203089.7331
DR097	98344074	47 32 50.54	122 20 06.77	1269528.0570	203284.2369
DR098	98344075	47 32 49.30	122 20 06.69	1269531.0920	203158.5125
DR099	98344076	47 32 47.62	122 20 07.91	1269444.0910	202989.9547

Table C-1—Duwamish River X & Y Coordinates by Station

Station	EPA Sample	N*	W*	X-Coordinate	Y-Coordinate
DR100	98344077	47 32 43.71	122 20 11.19	1269211.3800	202598.2484
DR101	98344078	47 32 44.52	122 20 12.72	1269108.0390	202682.3552
DR102	98344079	47 32 39.62	122 20 11.00	1269216.3190	202183.6594
DR103	98344039	47 32 38.15	122 20 10.70	1269233.9880	202034.3402
DR104	98344040	47 32 34.79	122 20 06.05	1269546.3020	201687.7304
DR105	98344057	47 32 33.23	122 20 01.30	1269869.0430	201523.3398
DR106	98344054	47 32 33.51	122 19 56.24	1270216.6850	201544.9404
DR107	98344053	47 32 34.18	122 19 52.56	1270470.4340	201607.8986
DR108	98344052	47 32 33.14	122 19 49.59	1270672.1100	201498.5772
DR109	98364029	47 32 33.17	122 19 53.62	1270395.7320	201506.9968
DR110	98344051	47 32 31.18	122 19 57.81	1270104.3910	201310.9995
DR111	98344055	47 32 32.63	122 19 59.59	1269985.1550	201460.2704
DR112	98344050	47 32 29.77	122 19 56.34	1270202.4440	201166.1957
DR113	98344058	47 32 26.70	122 19 52.95	1270428.9300	200850.6626
DR114	98344060	47 32 24.00	122 19 50.30	1270605.3900	200573.6025
DR115	98384003	47 32 23.20	122 19 47.53	1270793.8310	200488.8624
DR116	98344043	47 32 21.22	122 19 41.64	1271193.9790	200280.4256
DR117	98344044	47 32 18.99	122 19 41.35	1271209.4840	200054.1302
DR118	98344045	47 32 16.95	122 19 38.13	1271426.3640	199843.1791
DR119	98344046	47 32 15.28	122 19 36.99	1271501.2850	199672.4824
DR120	98334031	47 33 01.60	122 20 27.13	1268153.5500	204431.9687
DR121	98364014	47 32 59.82	122 20 27.80	1268104.0650	204252.5477
DR122	98384001	47 32 57.85	122 20 28.05	1268083.0080	204053.3145
DR123	98384002	47 32 56.22	122 20 29.68	1267967.9770	203890.3797
DR124	98384010	47 32 54.50	122 20 26.48	1268184.0390	203711.8359
DR125	98364015	47 32 58.69	122 20 26.94	1268160.8050	204136.9183
DR126	98334033	47 32 54.11	122 20 24.71	1268304.6640	203669.9495
DR127	98334034	47 32 52.09	122 20 23.56	1268379.5330	203463.7706
DR128	98334035	47 32 48.33	122 20 21.57	1268508.5680	203080.1950
DR129	98354082	47 32 44.67	122 20 19.61	1268635.7480	202706.7910
DR130	98334036	47 32 41.33	122 20 18.32	1268717.6110	202366.7040
DR131	98334039	47 32 37.71	122 20 16.88	1268809.2120	201998.0510
DR132	98334041	47 32 36.11	122 20 13.12	1269063.9550	201830.9226
DR133	98364034	47 32 32.99	122 20 08.02	1269407.6120	201508.0204
DR134	98334044	47 32 31.97	122 20 06.39	1269517.4040	201402.5075
DR135	98334046	47 32 27.91	122 20 02.37	1269785.1360	200985.8321
DR136	98334048	47 32 24.79	122 19 57.91	1270084.9180	200663.7983
DR137	98334050	47 32 22.69	122 19 55.42	1270251.5830	200447.7315
DR138	98364022	47 32 21.51	122 19 53.90	1270353.5250	200326.1617
DR139	98384004	47 32 21.62	122 19 56.34	1270186.3600	200340.5651
DR140	98364028	47 32 17.85	122 19 47.64	1270775.7440	199947.0305
DR141	98344080	47 32 17.49	122 19 46.73	1270837.4610	199909.3468
DR142	98344083	47 32 15.06	122 19 43.49	1271054.9430	199658.8561
DR143	98364020	47 32 13.25	122 19 40.70	1271242.7790	199471.7763
DR144	98344019	47 32 57.02	122 20 20.51	1268598.4980	203959.1057
DR145	98344021	47 32 49.04	122 20 16.98	1268824.7980	203145.9620
DR146	98344071	47 32 42.34	122 20 13.92	1269021.4150	202463.1204
DR147	98364033	47 32 36.20	122 20 07.79	1269429.7370	201832.8991
DR148	98344041	47 32 30.18	122 19 59.30	1270000.2100	201211.6870

Table C-1—Duwamish River X & Y Coordinates by Station

Station	EPA Sample	N*	W*	X-Coordinate	Y-Coordinate
DR149	98344061	47 32 23.96	122 19 49.11	1270686.9430	200567.9620
DR150	98344042	47 32 19.61	122 19 44.22	1271013.8230	200120.7647
DR151	98344047	47 32 14.14	122 19 36.36	1271542.2620	199556.1564
DR152	98354086	47 32 52.93	122 20 23.48	1268386.6860	203548.7587
DR153	98364017	47 32 45.41	122 20 19.87	1268619.3810	202782.1050
DR154	98334037	47 32 39.17	122 20 16.47	1268840.2270	202145.4053
DR155	98334042	47 32 34.09	122 20 10.46	1269242.4170	201622.7234
DR156	98334049	47 32 24.97	122 19 56.89	1270155.2430	200680.6698
DR157	98364021	47 32 21.73	122 19 54.02	1270345.7270	200348.6089
DR158	98344082	47 32 17.32	122 19 46.34	1270863.8800	199891.6048
DR159	98334053	47 32 12.40	122 19 38.37	1271400.9500	199382.5633
DR160	98334032	47 33 00.96	122 20 25.91	1268235.9530	204365.4949
DR161	98364016	47 32 54.21	122 20 21.52	1268523.6550	203675.7965
DR162	98354084	47 32 51.59	122 20 20.21	1268608.3110	203408.6213
DR163	98354083	47 32 48.88	122 20 17.71	1268774.4110	203130.7325
DR164	98344070	47 32 39.42	122 20 14.57	1268971.0480	202168.1835
DR165	98334040	47 32 36.78	122 20 11.36	1269186.0050	201896.4377
DR166	98334043	47 32 34.72	122 20 09.02	1269342.4390	201684.6161
DR167	98334045	47 32 30.71	122 20 01.37	1269859.2630	201268.1465
DR168	98334047	47 32 26.31	122 19 56.60	1270177.7810	200816.0300
DR169	98334051	47 32 23.56	122 19 53.11	1270411.7610	200532.7805
DR170	98334052	47 32 19.96	122 19 46.34	1270869.0810	200159.0485
DR171	98344069	47 32 14.50	122 19 39.75	1271310.4100	199597.1411
DR172	98344048	47 32 11.99	122 19 31.34	1271882.4200	199331.6708
DR173	98344049	47 32 09.88	122 19 28.40	1272079.9690	199114.0083
DR174	98344098	47 32 07.89	122 19 24.80	1272323.0370	198907.6275
DR175	98344097	47 32 05.31	122 19 20.97	1272580.7330	198641.1747
DR176	98364019	47 31 06.48	122 18 18.15	1276776.5290	192598.4795
DR177	98354003	47 32 08.26	122 19 11.04	1273267.7550	198926.8515
DR178	98354000	47 32 12.79	122 19 08.50	1273450.8700	199382.3965
DR179	98354002	47 32 11.47	122 19 07.66	1273505.9150	199247.5617
DR180	98354004	47 32 06.89	122 19 11.21	1273253.4110	198788.2894
DR181	98364025	47 32 07.68	122 19 10.96	1273272.1080	198867.9888
DR182	98354005	47 32 05.84	122 19 12.30	1273176.5770	198683.3642
DR183	98354006	47 32 03.77	122 19 17.82	1272793.8220	198480.9845
DR184	98344066	47 31 36.35	122 18 33.38	1275789.3830	195644.4777
DR185	98354073	47 31 36.14	122 18 32.85	1275825.3410	195622.5061
DR186	98354072	47 31 32.86	122 18 30.82	1275958.2610	195287.5548
DR187	98354070	47 31 27.39	122 18 28.10	1276134.2820	194729.8392
DR188	98354029	47 31 23.61	122 18 27.55	1276164.6850	194346.1832
DR189	98384005	47 32 11.20	122 19 38.13	1271415.0540	199260.6782
DR190	98334055	47 32 08.49	122 19 33.19	1271748.6280	198979.5663
DR191	98334061	47 32 06.21	122 19 29.98	1271964.3690	198744.3216
DR192	98334057	47 32 03.92	122 19 25.73	1272251.4450	198506.6841
DR193	98334059	47 32 01.65	122 19 20.79	1272585.9070	198270.1608
DR194	98344086	47 31 59.26	122 19 17.70	1272793.2180	198023.9413
DR195	98344089	47 31 56.99	122 19 14.17	1273030.9570	197789.2971
DR196	98344090	47 31 55.57	122 19 11.36	1273220.9670	197641.7192
DR197	98344092	47 31 53.82	122 19 09.48	1273346.5280	197461.9446

Table C-1—Duwamish River X & Y Coordinates by Station

Station	EPA Sample	N*	W*	X-Coordinate	Y-Coordinate
DR198	98344094	47 31 52.39	122 19 07.11	1273506.3360	197313.9394
DR199	98344095	47 31 51.40	122 19 05.06	1273645.0510	197210.9333
DR200	98344096	47 31 50.03	122 19 02.81	1273796.7470	197069.1677
DR201	98354064	47 31 48.80	122 19 01.11	1273910.9830	196942.3136
DR202	98354081	47 31 49.75	122 19 02.53	1273815.4110	197040.4318
DR203	98354066	47 31 46.01	122 18 55.80	1274269.8650	196652.6520
DR204	98354080	47 31 45.65	122 18 54.80	1274337.7750	196614.8608
DR205	98354078	47 31 42.46	122 18 49.83	1274672.5610	196285.1342
DR206	98354077	47 31 37.35	122 18 39.90	1275343.9530	195754.3690
DR207	98354076	47 31 36.34	122 18 38.63	1275429.1300	195650.3777
DR208	98354074	47 31 33.11	122 18 35.59	1275631.4430	195319.1589
DR209	98354071	47 31 30.34	122 18 34.25	1275718.0070	195036.7801
DR210	98354031	47 31 26.66	122 18 32.63	1275822.0180	194661.8456
DR211	98354030	47 31 24.72	122 18 32.00	1275861.4800	194464.4849
DR212	98344084	47 32 09.19	122 19 28.93	1272042.2550	199044.8129
DR213	98344085	47 32 06.98	122 19 24.57	1272337.0310	198815.1347
DR214	98344062	47 31 59.86	122 19 14.34	1273024.9130	198080.2670
DR215	98344063	47 31 54.64	122 19 04.83	1273667.1640	197538.8561
DR216	98344099	47 31 49.57	122 18 56.15	1274252.7980	197013.7596
DR217	98344065	47 31 44.64	122 18 46.40	1274912.1520	196501.4520
DR218	98344064	47 31 39.46	122 18 39.07	1275405.0080	195967.0288
DR219	98384007	47 31 32.32	122 18 31.38	1275918.7870	195233.5869
DR220	98354033	47 31 26.77	122 18 29.57	1276032.2080	194668.9633
DR221	98334056	47 32 08.13	122 19 31.24	1271881.6980	198940.5022
DR222	98334058	47 32 02.84	122 19 23.24	1272420.1550	198393.9669
DR223	98344087	47 31 58.49	122 19 14.90	1272983.8100	197942.2222
DR224	98344091	47 31 54.73	122 19 09.32	1273359.2860	197553.9199
DR225	98344093	47 31 53.73	122 19 07.40	1273489.0590	197450.0718
DR226	98354065	47 31 47.92	122 18 57.91	1274128.8210	196848.9333
DR227	98354079	47 31 43.31	122 18 49.91	1274668.7280	196371.3489
DR228	98364027	47 31 40.92	122 18 44.80	1275014.6880	196122.4874
DR229	98354075	47 31 37.23	122 18 37.77	1275489.8700	195739.4062
DR230	98354032	47 31 27.82	122 18 31.43	1275906.6150	194777.7803
DR231	98334054	47 32 12.15	122 19 36.13	1271554.1280	199354.2542
DR232	98334060	47 32 02.35	122 19 20.88	1272581.1040	198341.1935
DR233	98344068	47 31 51.96	122 19 02.08	1273850.6040	197263.7199
DR234	98344067	47 31 43.26	122 18 47.49	1274834.6750	196363.0895
DR235	98354063	47 31 30.30	122 18 32.31	1275851.0480	195030.1745
DR236	98354069	47 31 20.70	122 18 25.54	1276296.9670	194048.7434
DR237	98354025	47 31 16.39	122 18 23.93	1276399.0870	193610.0031
DR238	98354067	47 31 13.84	122 18 21.27	1276576.6820	193348.1810
DR239	98354068	47 31 10.28	122 18 20.27	1276638.4050	192986.2219
DR240	98354011	47 31 08.40	122 18 15.00	1276996.4210	192788.8519
DR241	98354009	47 31 10.04	122 18 10.80	1277287.8250	192949.4850
DR242	98354007	47 31 09.87	122 18 08.04	1277476.9030	192928.6465
DR243	98354010	47 31 08.21	122 18 10.97	1277272.6180	192764.3195
DR244	98364024	47 31 08.73	122 18 12.20	1277189.2140	192818.6106
DR245	98354012	47 31 06.84	122 18 15.72	1276943.9890	192631.7605
DR246	98364018	47 31 06.64	122 18 18.06	1276783.0150	192614.5702

Table C-1—Duwamish River X & Y Coordinates by Station

Station	EPA Sample	N*	W*	X-Coordinate	Y-Coordinate
DR247	98354059	47 31 03.28	122 18 18.19	1276767.5830	192274.3558
DR248	98354058	47 31 01.14	122 18 17.97	1276778.5350	192057.2742
DR249	98354052	47 30 56.77	122 18 17.14	1276827.0320	191613.4817
DR250	98354050	47 30 52.19	122 18 14.87	1276973.9540	191146.5259
DR251	98354043	47 30 51.70	122 18 14.50	1276998.3990	191096.4010
DR252	98354038	47 30 47.16	122 18 10.39	1277271.6950	190631.0865
DR253	98354037	47 30 46.07	122 18 06.24	1277554.4190	190515.2263
DR254	98354036	47 30 45.33	122 18 01.36	1277887.9260	190433.8717
DR255	98384019	47 30 44.10	122 17 54.31	1278369.4280	190300.0471
DR256	98384016	47 30 42.35	122 17 50.78	1278608.3370	190118.1514
DR257	98384015	47 30 40.46	122 17 46.56	1278894.3410	189921.1754
DR258	98354026	47 31 19.90	122 18 30.44	1275959.1670	193974.1425
DR259	98354023	47 31 15.89	122 18 27.86	1276128.4270	193564.5162
DR260	98364036	47 31 11.51	122 18 28.99	1276042.3790	193122.2864
DR261	98354021	47 31 08.95	122 18 26.90	1276180.8370	192860.1973
DR262	98364026	47 31 06.36	122 18 25.42	1276277.3780	192595.8718
DR263	98354018	47 31 00.22	122 18 23.21	1276417.1360	191970.9548
DR264	98354056	47 31 00.93	122 18 22.54	1276464.4940	192042.0012
DR265	98354053	47 30 55.90	122 18 21.79	1276506.2130	191531.4516
DR266	98354049	47 30 51.95	122 18 20.04	1276618.6610	191128.9983
DR267	98354042	47 30 49.76	122 18 19.20	1276672.0680	190906.0373
DR268	98354041	47 30 46.24	122 18 18.17	1276735.9390	190548.0913
DR269	98354040	47 30 44.08	122 18 16.86	1276821.6660	190327.5528
DR270	98354039	47 30 43.08	122 18 14.68	1276969.3540	190223.3873
DR271	98384020	47 30 40.94	122 18 05.83	1277572.6420	189994.9939
DR272	98354034	47 30 44.47	122 18 01.56	1277872.5380	190347.0110
DR273	98354035	47 30 43.49	122 18 01.49	1277875.4490	190247.6403
DR274	98384018	47 30 41.88	122 17 56.39	1278222.3830	190077.8682
DR275	98384017	47 30 40.37	122 17 52.26	1278502.9380	189919.5001
DR276	98384014	47 30 39.19	122 17 48.02	1278791.6840	189794.4232
DR277	98354027	47 31 19.51	122 18 26.30	1276242.5050	193929.1894
DR278	98354062	47 31 11.79	122 18 22.89	1276461.5350	193142.6336
DR279	98354061	47 31 05.75	122 18 20.40	1276620.7030	192527.4807
DR280	98354057	47 30 59.90	122 18 17.97	1276776.1330	191931.6559
DR281	98354051	47 30 53.15	122 18 16.34	1276874.9240	191245.7075
DR282	98354028	47 31 20.71	122 18 28.57	1276089.0620	194053.7399
DR283	98354022	47 31 11.36	122 18 26.74	1276196.4940	193104.1320
DR284	98354020	47 31 08.61	122 18 25.16	1276299.5860	192823.4664
DR285	98354019	47 31 05.39	122 18 24.39	1276346.1820	192496.2523
DR286	98354054	47 30 59.08	122 18 21.85	1276508.2610	191853.6804
DR287	98354048	47 30 49.87	122 18 19.36	1276661.2990	190917.3909
DR288	98354024	47 31 16.94	122 18 25.99	1276258.7910	193668.4281
DR289	98354060	47 31 02.27	122 18 20.64	1276597.4870	192175.2543
DR290	98354047	47 30 49.67	122 18 17.29	1276802.9820	190894.4126
DR291	98354046	47 30 46.22	122 18 15.23	1276937.6860	190542.2068
DR292	98354044	47 30 44.87	122 18 12.43	1277127.2490	190401.7723
DR293	98384006	47 30 43.33	122 18 01.22	1277893.6720	190231.0782
DR294	98384011	47 30 43.94	122 17 58.52	1278080.1650	190289.3422
DR295	98384012	47 30 42.02	122 17 53.20	1278441.6020	190087.8818

Table C-1—Duwamish River X & Y Coordinates by Station

Station	EPA Sample	N*	W*	X-Coordinate	Y-Coordinate
DR296	98384013	47 30 40.24	122 17 48.44	1278764.8800	189901.3420
DR297	98384021	47 30 30.37	122 17 32.98	1279807.0430	188881.3060
DR298	98384022	47 30 27.93	122 17 31.46	1279906.6900	188632.1427
DR299	98384024	47 30 22.53	122 17 36.42	1279555.8490	188091.5511
DR300	98384025	47 30 20.81	122 17 36.33	1279558.7200	187917.1886
DR301	98384023	47 30 25.75	122 17 32.81	1279809.8360	188413.0539

Corresponding ArcView data = allcoord.dbf, a corrected version of newcoor.dbf.

* = degrees, minutes, seconds.

APPENDIX D

CONTACT LIST

APPENDIX E

STATISTICAL SUMMARY AND DATA LISTING

SURFACE SEDIMENT

APPENDIX E-1

PESTICIDES/PCBS (SURFACE SEDIMENT)

APPENDIX E-2

BNAS (SURFACE SEDIMENT)

APPENDIX E-3

TOTAL INORGANICS (SURFACE SEDIMENT)

APPENDIX E-4

DIOXINS/FURANS (SURFACE SEDIMENT)

APPENDIX E-5

ORGANOTINS (SURFACE SEDIMENT)

APPENDIX E-6

VOCS (SURFACE SEDIMENT)

APPENDIX E-7

TOC/GRAIN SIZE (SURFACE SEDIMENT)

APPENDIX E

STATISTICAL SUMMARY AND DATA LISTING

SUBSURFACE SEDIMENT

APPENDIX E-8

PESTICIDES/PCBS (SUBSURFACE SEDIMENT)

APPENDIX E-9

BNAS (SUBSURFACE SEDIMENT)

APPENDIX E-10

TOTAL INORGANICS (SUBSURFACE SEDIMENT)

APPENDIX E-11

ORGANOTINS (SUBSURFACE SEDIMENT)

APPENDIX E-12

TOC/GRAIN SIZE (SUBSURFACE SEDIMENT)

APPENDIX E

STATISTICAL SUMMARY AND DATA LISTING

SURFACE SEDIMENT POREWATER

APPENDIX E-13

TOTAL INORGANICS (SURFACE SEDIMENT POREWATER)

APPENDIX E-14

ORGANOTINS (SURFACE SEDIMENT POREWATER)

APPENDIX F

SCREENING GUIDELINES

Table F-1—Summary of Sediment Quality Guidelines

Compound	Long & Morgan[d]		WA State SMS[e]		AETs[f]		MacDonald et al.[g]		PSDDA[h]		EP Marine[i]	
	ER-L	ER-M	SQS	CSL	LAET	2LAET	TEL	PEL	SL	ML	CHRONIC	ACUTE
Inorganics (mg/kg DW)												
Antimony	2.0	25			150	200			150	200		
Arsenic	8.2	70	57	93	57	93	7.24	41.6	57	700	33	64
Cadmium	1.2	9.6	5.1	6.7	5.1	6.7	0.676	4.21	5.1	14	31	96
Chromium	81	370	260	270	260	270	52.3	160				
Copper	34	270	390	390	390	390	18.7	108	390	1,300	136[a]	216[a]
Lead	46.7	218	450	530	450	530	30.2	112	450	1,200	132[a]	3,360[a]
Mercury	0.15	0.71	0.41	0.59	0.41	0.59	0.13	0.7	0.41	2.3	0.032[a]	0.6[a]
Nickel	20.9	51.6			>140	>140	15.9	42.8	140	370		
Silver	1.0	3.7	6.1	6.1	6.1	6.1	0.73	1.77	6.1	8.4		
Zinc	150	410	410	960	410	960	124	271	410	3,800	760[a]	2,240[a]
BNAs (µg/kg DW)												
2-Methylnaphthalene	70	670			670	1,400	20.2	201	670	1,900		
Naphthalene	160	2,100			2,100	2,400	34.6	391	2,100	2,400	500[b,c]	42,000[a]
Acenaphthylene	44	640			1,300	1,300	5.87	128	560	1,300		
Acenaphthene	16	500			500	730	6.71	88.9	500	2,000	16,500[b]	23,000[b]
Fluorene	19	540			540	1,000	21.2	144	540	3,600	59[b,c]	
Phenanthrene	240	1,500			1,500	5,400	86.7	543.5	1,500	21,000	110[b,c]	
Anthracene	85	1,100			960	4,400	46.9	245	960	13,000	190[b,c]	
Total LPAH	552	3,160			5,200	13,000	312	1442	5,200	29,000		
Fluoranthene	600	5,100			1,700	2,500	113	1494	1,700	30,000	1,600[b,c]	36,000[a]
Pyrene	665	2,600			2,600	3,300	153	1398	2,600	16,000	850[b,c]	
Benzo(a)anthracene	261	1,600			1,300	1,600	74.8	693	1,300	5,100	1,600[b,c]	220,000[a]
Chrysene	384	2,800			1,400	2,800	107.8	846	1,400	21,000	1,200[b,c]	
Total Benzofluoranthenes					3,200	3,600			3,200	9,900		
Benzo(a)pyrene	430	1,600			1,600	3,000	88.8	763	1,600	3,600	18,000[b,c]	
Dibenz(a,h)anthracene	63	260			230	540	6.22	135	230	1,900	12,000[b,c]	
Benzo(g,h,i)perylene					670	720			670	3,200		
Total HPAH	1,700	9,600			12,000	17,000	655	6676	12,000	69,000		
Phenol			420	1,200	420	1,200			420	1,200		
2-Methylphenol			63	63	63	72			63	77		
4-Methylphenol			670	670	670	1,800			670	3,600		
2,4-Dimethylphenol			29	29	29	72			29	210		

Table F-1—Summary of Sediment Quality Guidelines

	Long & Morgan[d]		WA State SMS[e]		AETs[f]		MacDonald et al.[g]		PSDDA[h]		EP Marine[i]	
Compound	ER-L	ER-M	SQS	CSL	LAET	2LAET	TEL	PEL	SL	ML	CHRONIC	ACUTE
Pentachlorophenol			360	690	360	690			400	690		
Benzyl alcohol			57	73	57	73			57	870		
Benzoic acid			650	650	650	650			650	760		
1,2-Dichlorobenzene					35	50			35	110		
1,3-Dichlorobenzene					170	170			170			
1,4-Dichlorobenzene					110	120			110	120		
1,2,4-Trichlorobenzene					31	51			31	64		
Hexachlorobenzene					22	70			22	230		
Dimethylphthalate					71	160			1,400			
Diethylphthalate					200	200			1,200			
Di-n-butylphthalate					1,400	1,400			5,100			
Butylbenzylphthalate					63	900			970			
Bis(2-ethylhexyl)phthalate					1,300	1,900	182	2647	8,300			
Di-n-octylphthalate					6,200	6,200			6,200			
Dibenzofuran					540	700			540	1,700		
Hexachlorobutadiene					11	120			29	270		
Hexachloroethane									1,400	14,000		
n-Nitrosodiphenylamine					28	40			28	130		
BNAs (µg/kg TOCN)												
2-Methylnaphthalene			38,000	64,000								
Naphthalene			99,000	170,000								
Acenaphthylene			66,000	66,000								
Acenaphthene			16,000	57,000								
Fluorene			23,000	79,000								
Phenanthrene			100,000	480,000								
Anthracene			220,000	1,200,000								
Total LPAH			370,000	780,000								
Fluoranthene			960,000	1,200,000								
Pyrene			1,000,000	1,400,000								
Benzo(a)anthracene			110,000	270,000								
Chrysene			110,000	460,000								
Total Benzofluoranthenes			230,000	450,000								
Benzo(a)pyrene			99,000	210,000								
Indeno(1,2,3-cd)pyrene			34,000	88,000								

Table F-1—Summary of Sediment Quality Guidelines

	Long & Morgan[d]		WA State SMS[e]		AETs[f]		MacDonald et al.[g]		PSDDA[h]		EP Marine[i]	
Compound	ER-L	ER-M	SQS	CSL	LAET	2LAET	TEL	PEL	SL	ML	CHRONIC	ACUTE
Dibenz(a,h)anthracene			12,000	33,000								
Benzo(g,h,i)perylene			31,000	78,000								
Total HPAH			960,000	5,300,000								
1,2-Dichlorobenzene			2,300	2,300								
1,4-Dichlorobenzene			3,100	9,000								
1,2,4-Trichlorobenzene			810	1,800								
Hexachlorobenzene			380	2,300								
Dimethylphthalate			53,000	53,000								
Diethylphthalate			61,000	110,000								
Di-n-butylphthalate			220,000	1,700,000								
Butylbenzylphthalate			4,900	64,000								
Bis(2-ethylhexyl)phthalate			47,000	78,000								
Di-n-octylphthalate			58,000	4,500,000								
Dibenzofuran			15,000	58,000								
Hexachlorobutadiene			3,900	6,200								
n-Nitrosodiphenylamine			11,000	11,000								
VOCs (µg/kg DW)												
Ethylbenzene					10	33			10	50		
Tetrachloroethene					57	140			57	210		
Trichloroethene									160	1,600		
Xylene (Total)					40	100			40	160		
Pesticides (µg/kg DW)												
Aldrin									10			
Chlordane	0.5	6					2.26	4.79	10			
Dieldrin	0.02	8					0.72	4.3	10			
Endrin	0.02	45										
Heptachlor									10			
Lindane							0.32	0.99	10			
p,p'-DDD	2	20			16	43	1.22	7.81				
p,p'-DDE	2.2	27			9	15	2.07	374				
p,p'-DDT	1	7			34	34	1.19	4.77				
Total DDT	1.58	46.1					3.89	51.7	6.9	6.9		

Table F-1—Summary of Sediment Quality Guidelines

Compound	Long & Morgan[d]		WA State SMS[e]		AETs[f]		MacDonald et al.[g]		PSDDA[h]		EP Marine[i]	
	ER-L	ER-M	SQS	CSL	LAET	2LAET	TEL	PEL	SL	ML	CHRONIC	ACUTE
PCBs (µg/kg DW)												
Total PCB	22.7	180			130	1,000	21.6	189	130	3,100	280	
PCBs (µg/kg TOCN)												
Total PCB			12,000	65,000								

[a]Based on 4 percent TOC.
[b]Based on 1 percent TOC.
[c]99th percentile value
[d]Long, E.R. and L.G. Morgan. 1990 with 1995 update. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOAA T
Memorandum NOS OMA 52.
[e]WAC 173-204
[f]Barrick, R., S. Becker, L. Brown, H. Beller, and R. Pastorak. 1988. Sediment Quality Values Refinement: 1988 Update and Evaluation of Puget Sound AET.
[g]MacDonald, D.D., R. Carr, F. Calder, E. Long, and C. Ingersoll. 1996. Development and Evaluation of Sediment Quality Guidelines for Florida Coastal Waters.
[h]PSDDA 1998 (http://www.nws.usace.army.mil/dmmo/sl_ml-t.htm)
[i]Equilibrium partitioning values as presented in Barrick et al., 1988 (see footnote f)
DW: Dry-weight
TOCN: Normalized to total organic carbon con
ER-L: Effects range-low
ER-M: Effects range-median.
SQS: Sediment quality standard
CSL: Cleanup screening level
AET: Apparent effects threshold
LAET: Lowest AET
2LAET: Second-lowest AET
TEL: Threshold effects level
PEL: Probable effects level
SL: Screening level
ML: Maximum level
Blank cell indicates criterion not available.

Table F-2—Summary of Porewater Screening Guidelines

Compound	Washington State Marine AWQC[c]		Federal Marine AWQC[d]	
	Chronic	Acute	Chronic	Acute
Inorganics (Total; µg/L)				
Antimony			500[b]	1500[b]
Arsenic	36[e]	69[e]	36	69
Cadmium	9.3[e]	42.3[e]	9.3	43
Chromium	50[e]	1108[e]	50	1100
Copper	3.7[e]	58[e]		2.9
Lead	8.5[e]	221[e]	8.5	220
Mercury	0.025	2.1[e]	0.025	2.1
Nickel	8.3[e]	75[e]	8.3	75
Selenium	71[e]	291[e]	71	300
Silver		2.2[e]	0.92[b]	2.3[b]
Thallium				2130[a]
Zinc	86[e]	95[e]	86	95
Organotins (µg/L)				
Tributyltin			0.01[b]	0.37[b]

[a]Insufficient data to develop criterion; value presented is the Lowest Observed Effect Level (LOEL).
[b]Proposed criterion.
[c]173-201A WAC (1997).
[d]U.S. EPA. 1995. Interim Draft Water Quality Criteria Summary.
[e]Total concentration back-calculated from dissolved criterion using marine conversion factors specified in WAC 173-201A.
AWQC: Ambient water quality criterion.
Blank cell indicates criterion not available.